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ORANGUTANS 30
NEW YORK'S
CHINATOWN 58
BOTTLENOSE WHALES 78
DAWN OF HUMANS 90
INDONESIA FIRES 100
TITANIC 120

Return to Mars

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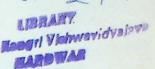
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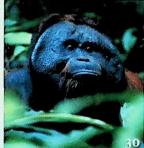
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AUGUST 1998

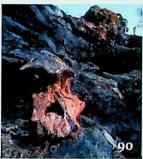
















- 2 **Return to Mars** Twenty-one years after NASA landed its first emissary on the red planet, Pathfinder touched down on July 4, 1997, and recorded images and data that astounded the world.

 BY WILLIAM R. NEWCOTT IMAGES BY NASA/JET PROPULSION LABORATORY
 - Tear-out: 3-D glasses for viewing photographs of Mars and Titanic
- Orangutans in the Wild Backbreaking fieldwork and meticulous attention to scientific detail bring a deeper understanding of the elusive red apes of the Borneo rain forest.

 BY CHERYL KNOTT PHOTOGRAPHS BY TIM LAMAN
- New York's Chinatown As immigration to New York surges, this vibrant Manhattan neighborhood provides Chinese newcomers a familiar setting in which to build their American dream.

 BY JOEL L. SWERDLOW PHOTOGRAPHS BY CHIEN-CHI CHANG
- 78 **Bottlenose Whales** At home in pitch-dark depths lethal to most marine mammals, these cetaceans may be the deepest divers of all. BY DOUGLAS H. CHADWICK PHOTOGRAPHS BY FLIP NICKLIN
- The Dawn of Humans South Africa yields fossil evidence that challenges old assumptions about humankind's beginnings.

 BY LEE BERGER PHOTOGRAPHS BY KENNETH GARRETT ART BY JOHN GURCHE
- 100 Indonesia's Plague of Fire Unchecked fires smolder throughout the rain forests of Sumatra and Borneo, spawning respiratory illness, traffic accidents, and food shortages across Southeast Asia.

 BY LEWIS M. SIMONS PHOTOGRAPHS BY MICHAEL YAMASHITA
- Titanic: Tragedy in Three Dimensions Computeraided editing transforms scenes from a diver's video into extraordinary still lifes of the somber wreck lying 12,500 feet below the surface. BY JOSEPH B. MACLENIS PHOTOGRAPHS EMORY COllection, Haridwar

Departments

Behind the Scenes Forum Geographica From the Editor

Flashback Point of View On Television Earth Almanac Interactive On Assignment

The Cover

Setting out to explore the Martian landscape, the rover Sojourner rolls toward a rock that scientists have named Barnacle Bill. View with the 3-D glasses enclosed. Image data by NASA/JPL; processing and color by Randolph Kirk, USGS

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SEPTEMBER 1998

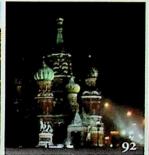
Gumbul Kangri Vishwavidyalawa













- 2 Valley of the Kings In a narrow valley near Luxor Egyptologists are excavating a royal tomb of unprecedented size, revealing new details of the lives of the pharaohs 3,000 years ago. BY KENT R. WEEKS PHOTOGRAPHS BY KENNETH GARRETT ART BY CHRISTOPHER A. KLEIN
- A New Day for Romania With the execution of dictator Nicolae Ceauşescu on Christmas Day, 1989, Romania threw off repressive communist rule. Now the nation struggles to find its place in a free-market, democratic Europe.

 BY ED VULLIAMY PHOTOGRAPHS BY ALEXANDRA AVAKIAN
- Greenland Sharks Lurking beneath the Arctic ice, huge sharks consume seals and other large prey as if they were mere morsels. For the first time these sluggish, nearly blind creatures are photographed in their frigid habitat.

 ARTICLE AND PHOTOGRAPHS BY NICK CALOYIANIS
- Vermont: Suite of Seasons Ever changing, ever the same, a far corner of the Green Mountain State known as the Northeast Kingdom qualifies as a special place to a longtime resident.

 BY EDWARD HOAGLAND PHOTOGRAPHS BY MICHAEL YAMASHITA
- 92 **Catherine the Great** Overthrowing her husband, Peter III, a German princess became Empress of Russia in 1762 and embarked on a 34-year campaign of empire building.

 BY ERLA ZWINGLE PHOTOGRAPHS BY SISSE BRIMBERG
- Borneo's White Mountain Riddled with networks of unexplored caves, 3,161-foot Gunung Buda harbors a wealth of plant and animal species in its depths and on its rain-forested slopes.

 BY DONOVAN WEBSTER PHOTOGRAPHS BY STEPHEN ALVAREZ

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The Cover

Found in the tomb of Tutankhamun, an alabaster container with finely carved stoppers carried the pharaoh's internal organs, preserved with natron, into the afterlife. Photograph by Kenneth Garrett

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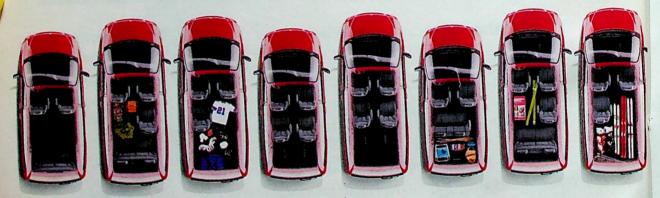
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interior into a variety of configurations is an exercise in convenience, not an



the longer wheelbase Grand Caravan, is 37. Which we figure is just about right for



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OCTOBER 1998









- POPULATION More people means more demands—for space, nourishment, security, opportunity. Can the needs of all be met?

 BY JOEL L. SWERDLOW
 - Millennium Supplement: Population
- 6 Human Migration We are constantly on the move, from countryside to city and nation to nation, driven by ambition, political upheaval, and natural disasters.

 BY MICHAEL PARFIT PHOTOGRAPHS BY KAREN KASMAUSKI
- Women and Population Birthrates fall and hopes rise as women gain access to education and health care.

 BY ERLA ZWINGLE PHOTOGRAPHS BY KAREN KASMAUSKI
- Feeding the Planet So far, global food production has kept pace with a burgeoning population. Maintaining that balance and finding ways to share Earth's bounty are critical challenges.

 BY T. R. REID PHOTOGRAPHS BY ROBB KENDRICK
- The Lewis and Clark Enthralled by "Barking Squirils" and unimagined vistas, these naturalist-explorers emerged from the newly acquired Louisiana Purchase in 1806 with a valuable treasure: a detailed account of the land and creatures of the Rockies and beyond.

 BY RON FISHER
- 94 **Perfume, the Essence of Illusion** Orchestrating the fragrances of nature—and their chemical counterparts—master perfumers create a commodity no one needs but almost everyone wants. The multibillion-dollar scent industry is smelling like a rose.

 BY CATHY NEWMAN PHOTOGRAPHS BY ROBB KENDRICK
- Antarctic Desert Scientists studying an ice-free enclave known as the Dry Valleys discover microscopic organisms living inside frozen rocks and minuscule worms that survive freeze-dried for decades.

 BY MICHAEL PARFICE-PHOPURIN POPULIN APPRINT COLLECTION, Haridwar

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Behind the Scenes Millennium Moments Forum Geographica From the Editor

Flashback On Screen Earth Almanac Interactive On Assignment

The Cover

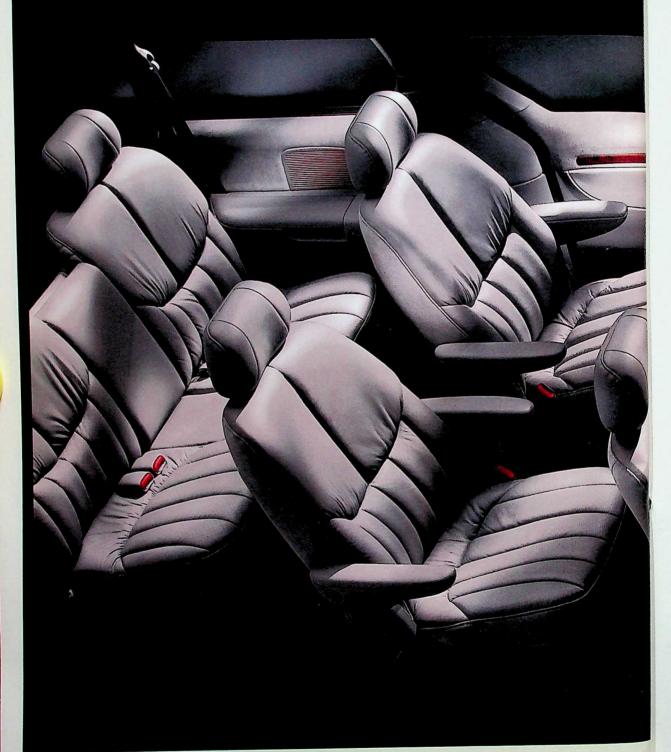
Glimpsing a brighter future, a girl clings to her pregnant mother, who waits—health card in hand—at a clinic in Bangladesh. Prenatal care has shaved mortality rates for mothers and babies. Photograph by Karen Kasmauski

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eight-way power, are heated and have two driver's seat memory settings.

NOVEMBER 1998



- America's Wilderness Early settlers saw the continent's forested wildlands as a fearful challenge. Today people seek nature to recharge their urbanized souls. Nearly 5 percent of U.S. land has been designated wilderness, but how it is used and managed is far from settled. BY JOHN G. MITCHELL PHOTOGRAPHS BY PETER ESSICK
- A Comeback for the Cossacks Armed with memories of bygone glory, a centuries-old warrior caste crusades for order and discipline in tumultuous modern Russia.

 BY MIKE EDWARDS PHOTOGRAPHS BY GERD LUDWIG
- Maui Surf A dozen times a year Pacific storms and the underwater topography of Maui's north shore combine to create monster waves called Jaws. Only a handful of surfers even try to ride the Hawaiian behemoths. BY JOEL ACHENBACH PHOTOGRAPHS BY PATRICK MCFEELEY
- Red Colobus Monkeys Deforestation and a low reproductive rate could spell the end for tree-dwelling monkeys on the increasingly crowded East African island of Zanzibar.

 ARTICLE AND PHOTOGRAPHS BY TOM STRUHSAKER
- 82 **Shackleton Expedition** After pack ice trapped their ship, explorer Ernest Shackleton and his men abandoned their dream of crossing Antarctica on foot and began a 20-month struggle to survive. BY CAROLINE ALEXANDER PHOTOGRAPHS BY FRANK HURLEY
- Abusir Tomb The crypt of an Egyptian priest, hidden deep below the sands and undisturbed for 2,500 years, promises to yield knowledge as valuable as a pharaoh's treasure.

 BY ZAHI HAWASS PHOTOGRAPHS BY KENNETH GARRETT
- Nebraska Street gangs have sprung up in Omaha, but heartland values hold firm in a land where neighbors are quick to lend a hand.

 BY ROFF SMITH PHOTOGRAPHS BY JOEL SARTORE

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Behind the Scenes Forum Geographica From the Editor

Flashback On Screen Earth Almanac Interactive On Assignment

The Cover

Expert surfer Laird
Hamilton plunges
down the face of a
colossal wave along the
north coast of Maui.
Photograph by
Patrick McFeeley

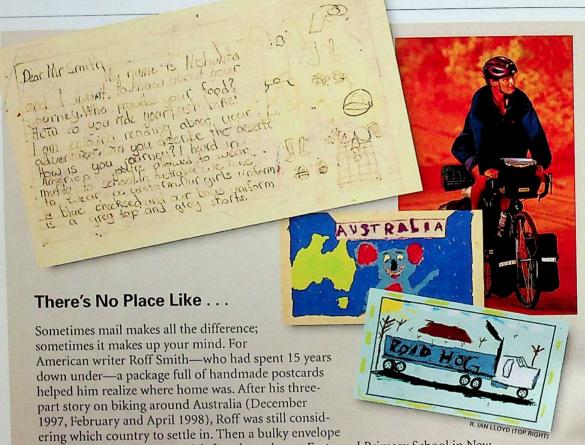
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Behind the Scenes



arrived. Teacher Annie Laurie's fourth graders at Eastwood Primary School in New South Wales had been inspired to create these postcards scrawled with messages of appreciation. "They firmed my resolve to start contacting real estate agents in South Australia," says Roff. The cards "made me realize again how much the place had become home. It was there all the time."



Cartographers Give Bend a Break

This year a group of Bend, Oregon, sixth graders changed the world—on paper. When student teacher Dan Taylor of High Desert Middle School noticed that Redmond, Oregon, rather than the larger town of Bend, was listed on our political map of the world as the only city in the state's central region, his students mounted a campaign to put their hometown on the map instead. Their research, detailing everything from the size of Bend's police force to the number of telephone prefixes, was enough to convince our cartographers, who were making revisions when the students contacted them. Now our new world map-distributed free this fall by the Society and its Education Foundation to every school in the United States—will have a Bend in the middle of Oregon.

DECEMBER 1998



- 2 **South China Sea** Carrying a third of the world's shipping, these waters are churned by the competing territorial claims of border nations. BY TRACY DAHLBY PHOTOGRAPHS BY MICHAEL YAMASHITA
- Dinosaur Embryos Unearthed from the wind-scoured landscape of Patagonia, exquisitely preserved eggs of plant-eating sauropods yield first ever fossils of embryonic dinosaur skin.

 BY LUIS CHIAPPE PHOTOGRAPHS BY BROOKS WALKER ART BY MICK ELLISON
- Barcelona A mixture of common sense and refreshing lunacy has turned this Spanish city into an economic powerhouse and international showcase—a model for a peaceful and prosperous Europe.

 BY T. D. ALLMAN PHOTOGRAPHS BY DAVID ALAN HARVEY
 - Double Map Supplement: Spain and Portugal
- Nunataks On icebound peaks that rise above the glaciers of Canada's Yukon Territory, flowers and insects flourish, lost migrating birds perish, and furry pikas survive by scavenging the dead.

 BY KEVIN KRAJICK PHOTOGRAPHS BY ROBERT CLARK
- Winslow Homer Big-spending collectors are snapping up the masterpieces of this American artist whose subjects ran the gamut of national life, from schoolyard games to the Civil War.

 BY ROBERT M. POOLE PHOTOGRAPHS BY SAM ABELL
- Body Beasts You've got company—and plenty of it. Mites make their home in your eyelash follicles, bacteria colonize your skin, and fleas and lice drop by for blood meals.

 BY RICHARD CONNIFF PHOTOGRAPHS BY DARLYNE A. MURAWSKI
- Petra, Ancient City of Stone Like smoke from a Bedouin campfire, a haunting sense of antiquity hangs over these immense carved ruins in the Jordanian desert.

 BY DON BELT PHOTO REPUBLIC BY MANNIE GRIFFITHS CRIETION, Haridwar

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Behind the Scenes Forum Geographica From the Editor

Flashback Key to 1998 Point of View On Screen Earth Almanac Interactive On Assignment Geoguide

The Cover

A Bedouin contemplates the craggy landscape of southern Jordan from a rooftop in Petra, the 2,000-year-old capital of the ancient Nabataeans. Photograph by Annie Griffiths Belt

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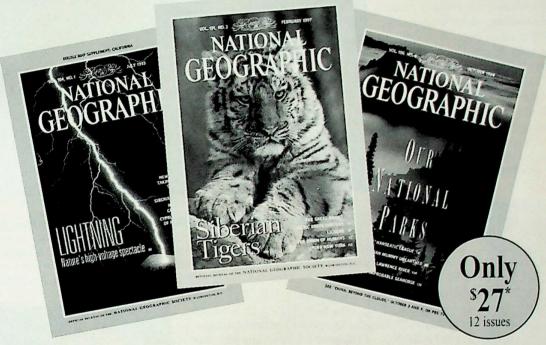
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NGAB104

Cure an Ailing Camel the Old Chinese Way

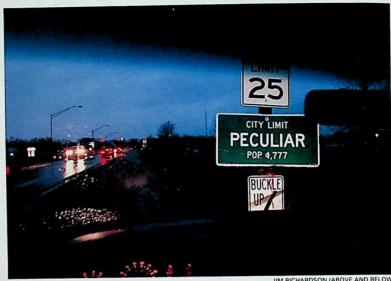
If your camel suffers from a "kidney cold"—an ailment you'll detect when it scratches its flanks while walking-here's the cure: a potion made of coarse cinnamon bark, magnolia bark, and onions cooked in wine.

That prescription comes from an 11th-century Chinese manual (detail below), the world's oldest existing treatise on camel medicine. Recently translated into German by Herbert Franke, a Chinese history specialist, it

sheds light on Chinese attitudes toward the Bactrian camel, for centuries vital as a beast of burden and tended for its milk, meat, and dung.

The manual's medical guidance is analogous to traditional

Chinese medicine for humans, says Angela von den Driesch, a historian of veterinary medicine at the University of Munich. In fact, acupuncture is urged in treating such camel illnesses as joint infection, disease of the spleen, and a neck deformity called wryneck.



JIM RICHARDSON (ABOVE AND BELOW)

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It's Odd (West Virginia) and a Novelty (Ohio)

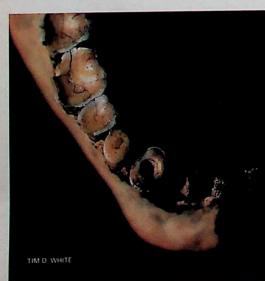
There's nothing peculiar about Peculiar, Missouri, Frank Gallant learned in researching a book about unusual American placenames. In 1868 the town's first postmaster proposed names that

Washington, D.C., kept rejecting. Exasperated, he wrote the Postmaster General asking him to take over the job: "We don't care what name you give us so long as it is sort of peculiar." And so it was.

Gallant, the editor of Rural Electrification Magazine, found that many places got



their names by accident or error. Correct, Indiana, for example, is incorrect; its residents' choice, Comet, was misread. Residents of Lolita, Texas, sought a new moniker in vain after a novel by that name gave it unwanted—and lurid—overtones. And Dorothy, the heroine of The Wizard of Oz, would be happy to know there really is a place like Home in Kansas.



Too Early for Painless Dentistry

You think you hate going to the dentist? University of California researchers studying this thousandyear-old jaw, found at a Colorado archaeological site, discovered that a hole had been carefully drilled in a tooth, perhaps to treat a cavity. They duplicated the hole in a modern tooth, drilling with an obsidian point affixed to a wooden dowel. Meanwhile, near Paris, scientists examining a 2,000-yearold male skeleton found a wrought-iron implant replacing an upper bicuspid. Apparently the man had taken his tooth to a blacksmith, who made a replica, says anthropologist Eric Crubézy. The replacement was shoved in place—and it "took." TEXT BY BORIS WEINTRAUB

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THE NISSAN PATHFINDER

THE NASA PATHFINDER



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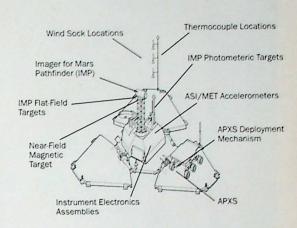
Enter the Nissan Pathfinder Mars Sweepstakes and you could win the Grand Prize of a pre-paid, 2-year lease of a 1998 Nissan Pathfinder SE. Just find the answers to the questions below in the 28-page section, "Return to Mars." Then send your answers on a postcard or enter via our web site at www.nissansweepstakes.com to be eligible. First Prize includes an all-expenses-paid trip for two to Washington, D.C., where you'll meet an astronaut, visit the National Geographic headquarters, and get a behind-the-scenes look at the Smithsonian's Air & Space Museum. Thirty runnersup will receive autographed copies of the special edition book, "Mars". But read fast. Contest ends 9/30/98.

QUESTIONS:

- · What does APXS stand for?
- Mars gets its red color from?
- How long does a day on Mars last?
- · Temperatures on Mars range from:
- · How much of Mars did the rover explore?
- Which air conditioning system would you find in the Pathfinder on the next page?

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Embark on your own Mars Pathfinder mission. (Without the deadly toxic atmosphere.)



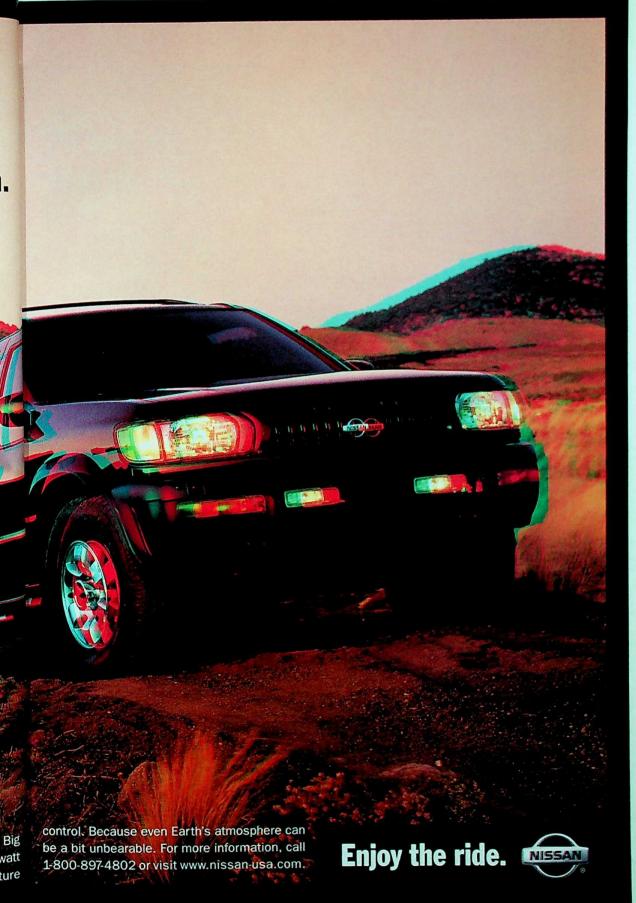
The Nissan Pathfinder SE is fully equipped for a successful exploration of our own planet Earth. Big mud-and-snow radial tires. An advanced, shift-on-the-fly,* 4WD system. An available 6-speaker, 150-watt Bose CD/stereo system. And a comfy, CFC-free air conditioning system with automatic temperature

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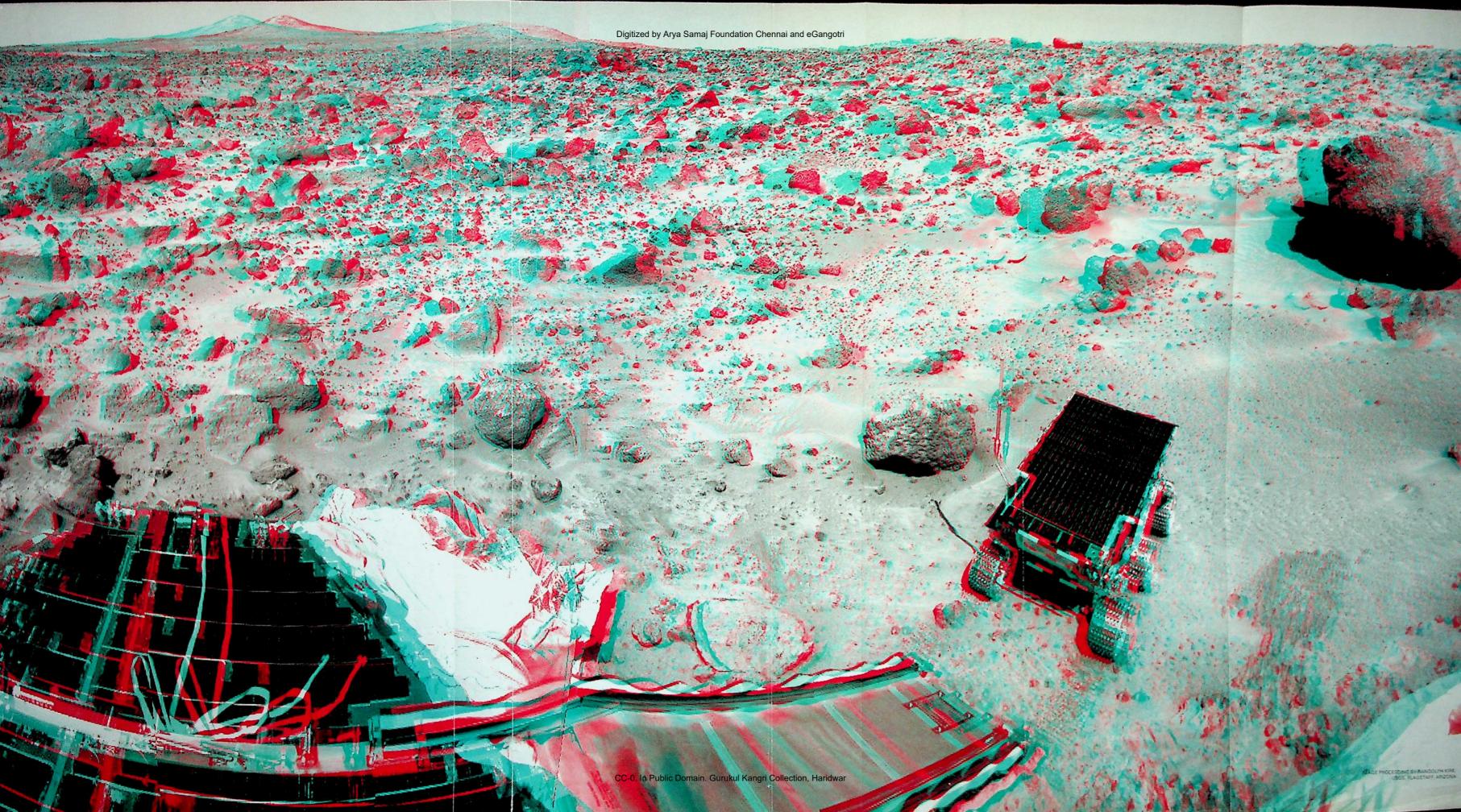


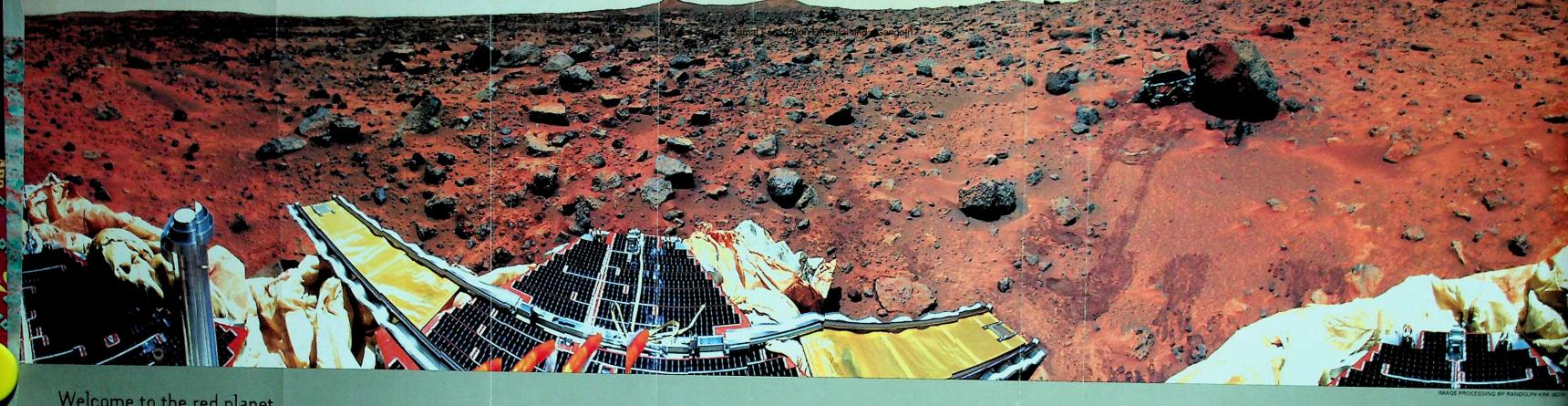
Welcome to the red planet

unfold before you at solar panel that bears, at extreme left, a slim the trip from Earth atop the second panel from the left, has been remotely driven down

called Barnacle Bill. ging away soil as fin a hard white material. Its composition YOGI appears to match the from B of Scooby Doo, a sul rock bi stance that the rover far mo spiked wheels could that a not scratch.

Rumpled under the panels are deflated a





Welcome to the red planet

"Well, we wanted rocks," says Pathfinder project scientist ever analysis of rocks Matthew Golombek, "and we got rocks." If you were seated in a circular track nearest swivel chair with your the lander while head five feet above ground, this is the panorama that would unfold before you at the Ares Vallis landing a second circle, digsite. The 360 degree image begins and ends in the middle of a a hard white matesolar panel that bears, rial. Its composition at extreme left, a slim appears to match that enhance the contrast meteorology mast. The rover, which made stance that the rover's soil. Its second day on the trip from Earth atop the second panel not scratch. from the left, has been

already begun the first looned into a protecon another planet. Sojourner made the investigating a rock called Barnacle Bill. Visiting a rock called Yogi, the rover made ging away soil as fine of Scooby Doo, a subspiked wheels could

Rumpled under the remotely driven down panels are deflated air

bags, which had bal-Pathfinder just ten one of four made by the lander's camera. in segments over a slightly redder and rocks more gray to

three-day period. as flour and revealing Reds have been made between rocks and named the Carl Sagan Memorial Station for

METEOROLOGY MAST

Martian winds can reach a hundred miles an hour, but in nearly three months the breezes measured by Pathfinder's wind sensors never topped 20 miles

BIG CRATER Many of the dark, angular rocks near the lander may have been ejected when a meteorite crashed into Mars, creating this 4,900foot-wide crater more

ROCK GARDEN Left in a catastrophic ancient flood, these rocks were a prime target for Sojourner.

BARNACLE BILL The first of eight rocks studied by Sojourner's alpha-proton x-ray spectrometer, Barnacle Bill is high in silicon, as is the continental crust

YOGI About six feet away from Barnacle Bill, Yogi may be a similar type of rock but is covered with far more dust. Its perch and round shape suggest that a flood put it here.

SCOOBY DOO Like the material that Sojourner uncovered in front of Yogi, Scooby Doo appears to be composed of chemically cemented drift.

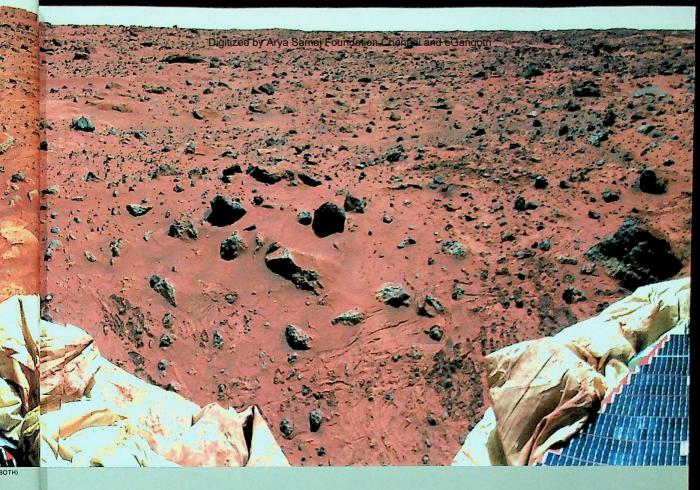
ROADRUNNER FLATS MINI MATTERHORN One of many dune structures visible from Path-

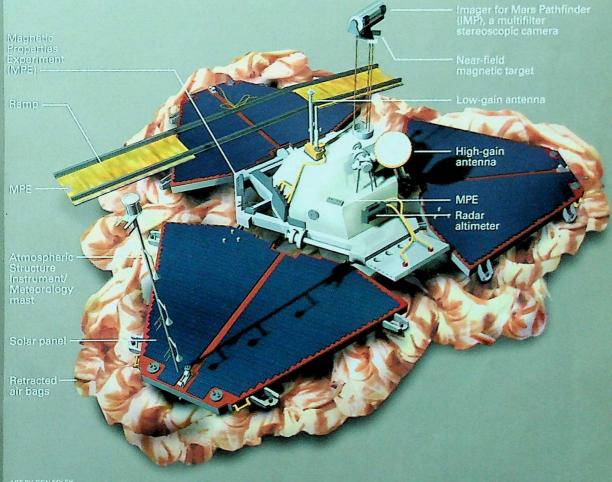
finder, but never visited

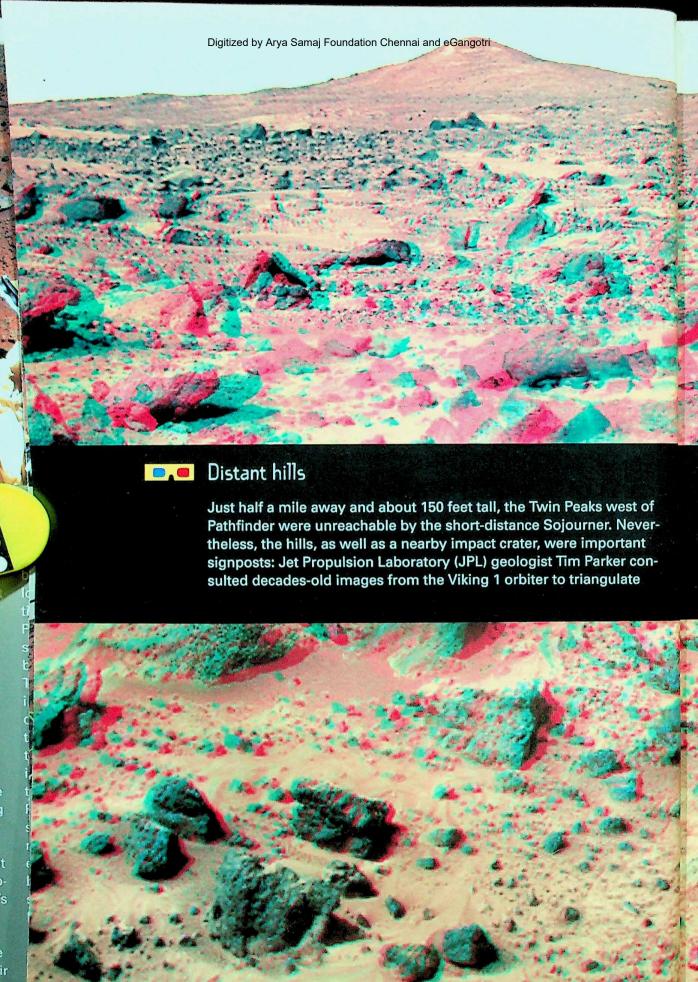
reflective than any dune seen before on Mars.

by the rover, it is more

The lander nearly toppled when its deflated air bags snagged on this boulder while retracting. Even if it had tipped, the lander was capable of righting itself.







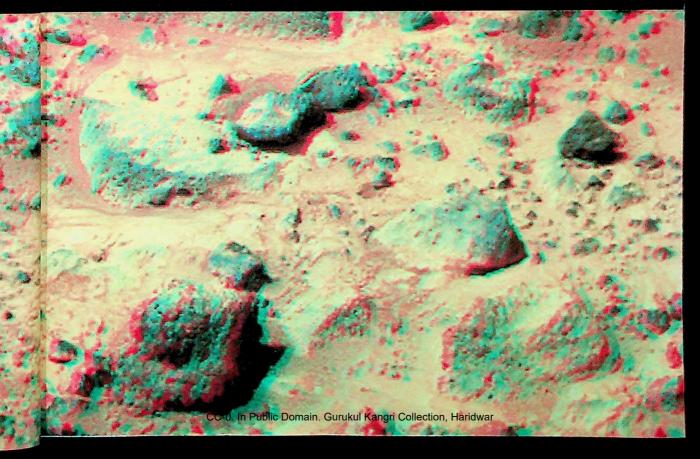
Public Domain, Gurukul Kangri Collection, Haridwar

the landmarks and within hours pinpointed Pathfinder's whereabouts. The lander was equipped with a stereo camera so scientists could view the surface—like the area in front of the Rock Garden (below)—in three dimensions to understand the topography and navigate the rover.

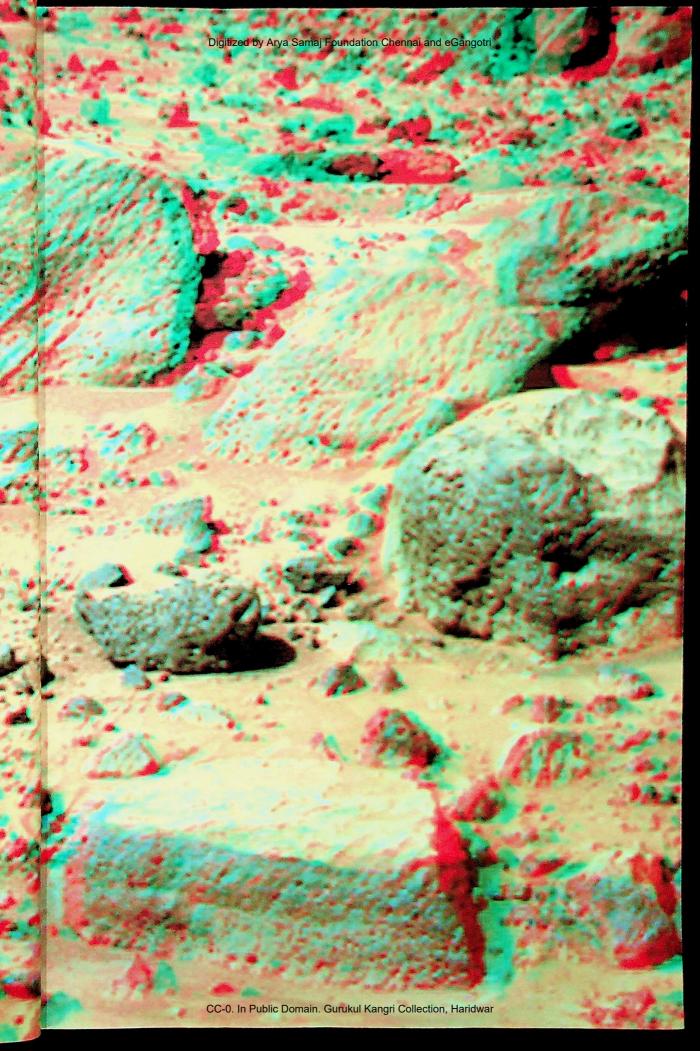
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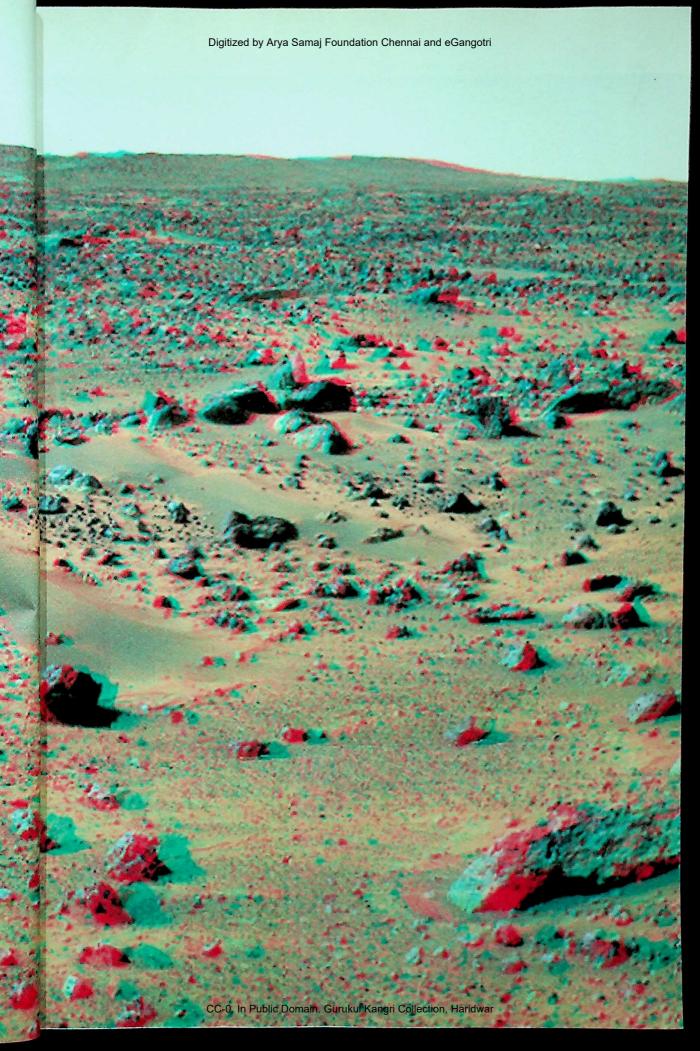
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Blue sky at night . . .

The setting sun tints the sky blue (above) as light is scattered by particles of airborne red dust. Similarly, scattering by tiny water-ice particles lends a blue hue to wispy high-altitude clouds passing overhead near dawn (right). Gray clouds (below), colored by icy dust particles, give an overcast morning an Earthly quality—on a clear day the Martian sky is butterscotch.





HE MIDSUMMER SUN was high in a clear yellow-brown sky. The morning's filmy blue clouds had dissipated, and the temperature was 8°F—way up from last night's low of minus 100°. A breeze wafted from the west at about eight miles an hour.

A perfect afternoon for a drive on Mars.

Gingerly pushing a joystick, I watched the computer screen as the six-wheeled rover named Sojourner eased away from the Mars Pathfinder lander, which had carried it to this rocky Martian plain 119 million miles from Earth. The two-foot-long vehicle rolled along a Mars landscape replicated from images beamed back to Earth after Pathfinder's landing on July 4, 1997.

I was not, of course, commanding the real rover. By the time I sat down at this computer terminal at the Jet Propulsion Laboratory (JPL) in Pasadena, California, Pathfinder had been out of contact for weeks. But if the lander had still been alive, I could have been plotting real rover maneuvers at this computer.

An intriguing collection of rocks lay a few yards to the left of the rover, but a pair of goodsize stones seemed to block my path. Luckily I was wearing liquid-crystal 3-D glasses that enabled me to see depth on the flat computer monitor. There would be just enough room for me to squeeze Sojourner through—I thought.

"Um, you may have a problem there," said a charitable Brian Cooper, who designed this virtual-reality computer program for the Jet Propulsion Laboratory and served as the primary designated driver for the actual rover's three-month mission. From this very console in his JPL office, the bearded, shirt-sleeved Cooper plotted the moves of the interplanetary dune buggy.

Fortunately for the U.S. space program, my navigational mishap happened off-line. As opposed to my blunderings (somehow I found a way to make the virtual rover rise into the air and fly off into the distance, growing ever tinier as it disappeared over the Martian horizon), Cooper found routes around barriers, stopped to spin the rover's wheels so scientists could study the soils stirred up, and cozied up to rocks for closer looks.

"Don't feel too bad," Cooper told me. "We spent so much time in one area that I nicknamed it the Bermuda Triangle."

With the goggles and video-game graphics, this all seemed like entirely too much fun for real science. In fact, from the beginning there was a vague sense of goofy abandon to the Pathfinder project. The spacecraft was designed, built, and launched in three years. The mission's total cost ran 265 million dollars, one-fourteenth the amount of the last successful Mars missions, Viking 1 and 2, in 1976. The rover was so cute that a copy became one of the most popular Hot Wheels toys ever produced. Even the landing was offbeat: At 1,165 feet above the surface, after being slowed by the atmosphere and a parachute, the lander sprouted multiple air bags, cushioning itself inside a huge beach ball. It bounced more than 15 times across the Martian surface before rolling to rest on a gentle slope.

The air bags were deflated and cranked back around the lander, which then unfolded its petal-like shields to reveal the payload: the Imager for Mars Pathfinder (IMP), a stereoscopic camera with 24 filters; the Atmospheric Structure Instrument/Meteorology (ASI/MET)

package to record daily weather; and the rover itself, with cameras on the front and back and an alpha-proton x-ray spectrometer (APXS) to analyze the makeup of Mars rocks and soil.

That may seem like an ambitious lineup, and those devices did come up with some remarkable discoveries. But at its inception the main aim of the entire Pathfinder mission was simply to get something—anything—safely on Mars.

"This was primarily an entry, descent, landing demonstration," said Matthew Golombek, the project scientist whose wide-eyed smile and unbridled enthusiasm endeared him to TV viewers as Pathfinder's spokesman. "After we had the thing on the surface, whatever we did was pretty much considered gravy."

From his windowless little office on the JPL campus, Golombek oversaw the Pathfinder science mission. "They probably let me have the job thinking I wouldn't cause them too much trouble," he smiled. "But I thought it would be silly just to send a red brick to Mars. I figured we should try to learn something new."

The learning began even before the landing. During the descent the spacecraft recorded information about the planet's atmosphere.

Finally on the ground in a region called Ares Vallis, the IMP camera showed rocks—large and small, angular and rounded, dark and bright—stretching to the horizon. To Golombek the landscape was gratifyingly familiar.

"I spent two and a half years worrying about the landing site," he said. "We knew from old Viking images that there were areas of Mars that looked like they had been formed by catastrophic floods. On Earth places like that are where you can get a variety of rocks, so that was where we wanted to go."

As 3-D images of the surface were processed, it became clear that some kind of trough lay just beyond a nearby ridge. Set on the trough's edge like books on a shelf was a collection of angled rocks. The consensus grew that what carved the trough and deposited many of the rocks at Pathfinder's landing site was a flood whose volume may have equaled that of all the Great Lakes.

And when the rover ventured off the lander, it saw rocks that are possibly conglomerates, a type of rock that forms over millennia as water rounds pebbles and cobbles and deposits them in a matrix of sand and clay. "That means

there was once liquid water on Mars," said Golombek. "It suggests a very different climate, perhaps one where life could have developed. That raises the questions: If life developed, what happened to it . . . and if not, why not?"

there was something different about the bright red heavenly body that marched across the night sky out of step with the steady progression of the stars. The ancient Sumerians, Greeks, and Romans associated it with their god of war, unaware that its bloodred color was merely evidence of a world covered with iron oxide dust.

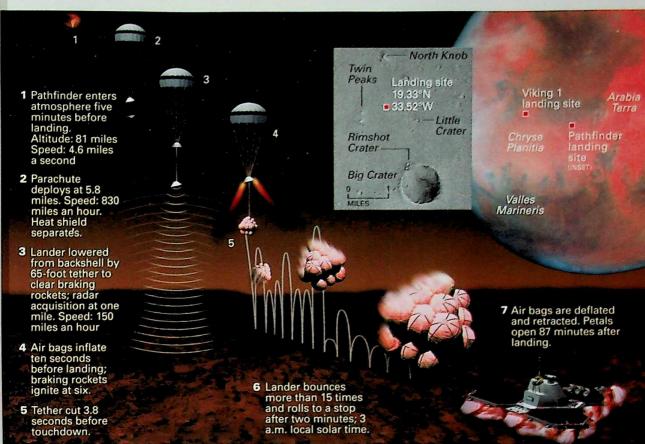
In the late 1800s an Italian astronomer named Giovanni Schiaparelli mapped what he described as *canali* on the Martian surface. The word can mean either natural channels or artificial canals, and Percival Lowell, a Boston millionaire and astronomy enthusiast, seized on the more tantalizing translation. He decided he would see those Martian canals for himself. And he spared no expense.

Lowell called the Arizona mesa on which he established his observatory Mars Hill. Back in 1894 it was in the middle of nowhere. Today it's a five-minute drive from where old Route 66 passes through Flagstaff. Stroll up a pathway—past the domed mausoleum where Mr. Lowell's remains lie—and you're at the door of the wooden cylindrical building that houses the 24-inch refracting telescope he brought to the site by train.

Lowell spent years squinting through the telescope, drawing the intricate patterns he saw—or imagined he saw—on the Martian surface. The canals, he said, stretched from the cold ice caps to regions closer to the equator. It was clear to Lowell that Mars was a drying, dying planet and that its ingenious inhabitants had created the canals in a last-ditch attempt to survive.

It was, needless to say, one of the great wrong guesses in astronomical history. But Lowell helped propel a century of Mars studies—along with classic science-fiction books and movies that planted the seed of Martian curiosity in the young minds of more than a few future scientists.

Science fiction aside, Mars is in many ways remarkably like Earth. A day on Mars lasts 24 hours, 37 minutes. The Earth's axis tilts at



ART BY DON FOLEY, HUBBLE SPACE TELESCOPE IMAGE OF MARS, STEVEN LEE, UNIVERSITY OF COLORADO, BOULDER, INSET: MALIN SPACE SCIENCE SYSTEMS/NASA

23.43 degrees; Mars's tilts at 25.19 degrees. Both planets have observable seasons, with warm summers that melt their polar ice caps. Clouds drift across the face of each. Mars is half again as far from the sun as Earth, yet while polar nights are nearly minus 200°F, summer days south of the equator can get as hot as 80°.

Although the diameter of Mars is little more than half that of Earth, its major geological features dwarf those on our planet. The Martian volcano Olympus Mons rises 75,000 feet, two and a half times the height of Everest. And the Valles Marineris canyon, which would stretch from San Francisco to New York, is the longest such valley known in the solar system.

The more Earthlings learned about Mars, the less it remained an astronomical curiosity. Mars was a place to go.

Elton John sang in the 1970s, "Mars ain't the kind of place to raise your kids / In fact it's cold as hell." Dusty, pockmarked, dead: This was the view of Mars sent back to Earth by the Mariner flyby missions of the 1960s. The black-and-white

BOUNCING INTO HISTORY, Pathfinder makes its unorthodox arrival on Mars. Air bags were ideal for the rocky landing spot—near the mouth of the Ares Vallis flood channel—seen in a 1998 Mars Global Surveyor image (inset).

images showed a planet that looked positively moonlike. Impact craters were everywhere. Then in the early 1970s the Mariner 9 orbiter showed intriguing evidence of volcanism and dry riverlike flood channels. Two 1976 landers, Viking 1 and 2, looked for life on Mars by scooping up and testing soil samples, which yielded no organic material.

For nearly two decades after the Vikings, Mars remained unvisited by the United States. (The Soviet spacecraft Phobos 2 orbited the planet for a month in 1989.) A grand return was planned with the Mars Observer probe, which bristled with experiments, sensors, and cameras. A week before its planned arrival in August 1993 a scientist showed me a single black-and-white image of Mars taken by Observer to test the equipment.

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MEN FOR MARS share a jubilant hug when confirmation of Pathfinder's successful landing was beamed to Earth July 4. 1997. Chief engineer Rob Manning, facing camera, will continue his role in all robotic Mars exploration-a task that will extend through the next decade. NASA plans at least four more missions, all of them with landers.



BILL INGALLS, NASA

I told him, "this will be the most expensive eight-by-ten glossy ever taken." We laughed. Days later Observer fell silent.

The Mars Observer debacle came at the end of an era: The age of spending a decade or more developing, building, and launching a space probe was over. NASA's chief, Dan Goldin, summarized the future of space exploration in three words: "Faster, better, cheaper."

NASA announced that spare parts for Observer would be assembled on a new craft called Mars Global Surveyor. It would be launched as soon as possible, the first in a series of Mars orbiters, landers, and rovers that included Pathfinder.

With its three-year deadline and strict budget, the design and assembly of Pathfinder was unlike any space project before it. In the old days a device as critical and complex as the IMP camera would have been built entirely by a government contractor. But now, to save money, the final assembly and testing was done by scientists, engineers, and graduate students at the University of Arizona Lunar and Planetary Laboratory in Tucson.

"In the past, large teams were common on this kind of project," said Peter Smith, the imaging team leader who conceived the camera at the University of Arizona, helped build it, and then supervised its operation on Mars. "This had no more than 20 employees. Traditionally with contractors the cost of the camera would have run in the tens of millions of dollars. Ours cost less than six million."

> Tall, bearded, and obviously more comfortable in knit polo shirts than anything else, Smith recalled the hectic last days of building the camera in December 1995.

"The motors for pointing the camera arrived here at the university on December 20, and the camera was due at IPL December 29. That was the Christmas from hell, but we worked very long hours and got the thing packaged at 4 a.m. on the 29th.

"Before sending the camera to JPL, my colleagues Chris Shinohara and Bob Marcialis and I put it on my dining room table and toasted it with warm beer, the only thing we could find at five in the morning. That was real team spirit."

The Global Surveyor orbiter was launched first, in November 1996. Pathfinder was hurled into space a month later, on a trajectory that brought it to Mars two months sooner. The media sensation Pathfinder caused was unlike that of any space program since Apollo. In the first month of surface operations the JPL Mars Pathfinder Internet site registered an unprecedented 566 million hits.

N A JPL CONFERENCE ROOM a blowup of the Martian panorama surrounding the Pathfinder lander stretched nearly wall to wall. Almost obliterating the image were over a hundred yellow adhesive Post-its bearing the whimsical descriptive names that scientists had given Martian rocks. Names like Barnacle Bill, Yogi, and Couch.

"It seemed like a better idea than just assigning them numbers," said the young scientist showing me around. "But they were careful not to give them the names of any real people. Too much danger of jealousy."

At that moment my eye caught sight of a rock named Moe, so named, it appeared, for its shaggy "haircut." A momentary lapse, I supposed. And so it came to pass that the only feature the mission named for a person honors the memory of Moe Howard, the eye-poking, skillet-wielding leader of the Three Stooges.

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Each day during the mission Brian Cooper, the rover driver, sat at his computer screen and mapped out Sojourner's route, a trail the rover followed at a blistering two feet a minute.

Cooper couldn't simply rev it up and drive it around like a kid with a remote-control car though. Each new route had to be painstakingly planned and tested by the rover team. That's why Cooper had to develop a computer program that enabled him to envision the rover in the Mars landscape. He rehearsed the day's intended route at JPL, then sent the set of commands, the radio signals taking some ten minutes to reach Mars. He gave the rover way points, then let it head for the destination on its own, using five lasers and two cameras for range finding and to see what was in its path.

"The cameras and lasers worked as an avoidance system," he said. "Even if I told the rover to go off a cliff, it wouldn't do it."

Cooper watched me fumble with his baby. Finally, a confession. "I think this is the most fun job on the whole project," he said. "I've had a blast."

Cooper's most delicate procedure was to maneuver close enough to rocks for the rover's APXS sensor, at the end of a short movable arm, to be pressed against them.

"We found rocks very high in silicon, which indicates that some crustal materials are like the continental crust on Earth," said Matthew Golombek, the project scientist.

HE PATHFINDER LANDER transmitted its last data on September 27. Though twice revived by JPL scientists, it sent no further information. Wild Martian temperature changes probably caused a wire to snap or a soldering point to crack. The solar-powered rover, however, may still be rolling around, using its laser eyes to dodge rocks as it circles the lander like an orphaned pup. More likely, the rover has at some point sensed itself in a precarious position and placed itself on hold,

LOOK FAMILIAR? Take away the blue skies and the distant water and this rocky plain in Iceland could be Martian. Boulders and smaller sediments here were deposited in a flood, as were the sediments in Ares Vallis. Pathfinder team members visited similar floodplains in Washington State to predict what they would find at their landing site.



MIKE MALIN, MALIN SPACE SCIENCE SYSTEMS

waiting for instructions that will never come.

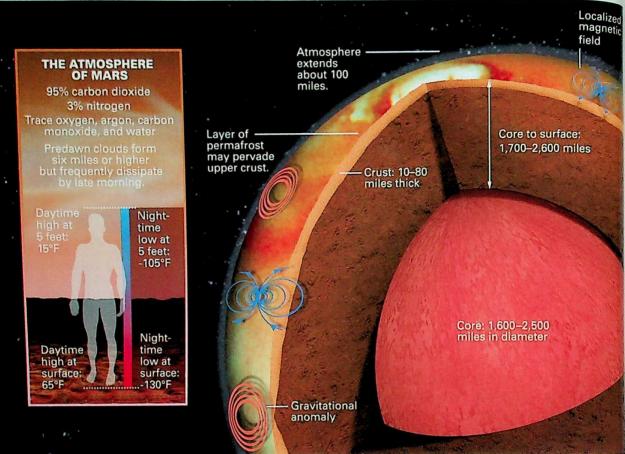
By September 27 the rover had covered about 110 yards of terrain and taken 16 APXS readings of Mars rocks and soil. The lander and rover sent back more than 17,000 images. Almost daily weather recordings tracked temperature, air pressure, and wind speed and direction, including several small, swirling dust devils passing right over the lander. "In short," said Golombek, "we have explored about 240 square yards of Mars."

Like most Pathfinder scientists, Golombek keeps coming back to the mounting evidence that Mars, like present-day Earth, once had bodies of water lapping against the now dry landscape.

Even in its dryness Mars betrays a watery past. All around Pathfinder were windblown dune forms. Rocks visible from the lander had been sculpted by wind, a phenomenon that requires airborne sand as an abrasive. On Earth you need running water to make sand.

And there were more signs of water on Mars. One of the experiments added to the Pathfinder payload was a series of magnets on the

RETURN TO MARS



ART BY DON FOLE

MORNING ON MARS brings wild temperature change. As the sun warms the surface, heat rises in eddies. Measurements made using the lander's radio communications system show that Mars has a metallic core. The Mars Global Surveyor detected no global magnetic field but rather many localized fields and gravitational anomalies.

lander. As the weeks on Mars wore on, the IMP camera saw dust collecting around the magnets. The patterns confirmed that the particles, just two microns across, were highly magnetic—interpreted as evidence that iron in the crust was once leached out by groundwater.

Soon after Pathfinder's last transmission, Mars Global Surveyor began sending back remarkably high-resolution images of the Martian surface. As it orbits Mars, Global Surveyor is using the atmosphere to slow itself down until it attains an ideal operating orbit in March 1999. Meanwhile, its near-spy-satellite-quality camera has revealed that the walls of Valles Marineris have sharply defined layers, like the Grand Canyon. The orbiter's laser

altimeter, which measures the distance from the satellite to the planet's surface, appears to show that the north polar cap rises much higher than previously thought, in places almost a mile above the relatively flat, sandy plains that surround it. The laser altimeter also shows a vast flat region covering much of Mars's northern hemisphere—possibly an extinct seabed or ancient mudflat.

Said Golombek, "It just seems that everywhere you look on Mars, you see water. At least the evidence of it."

So where did it go? The prevailing view holds that most of Mars's water is frozen—at the poles, underground, or on the planet's northern plains. But life cannot exist without liquid water. No water . . . no Martian life.

AN McCLEESE got hooked on Mars early. As a 16-year-old in San Diego, his high school science project was to try to grow slime mold in a simulated Mars environment. Young McCleese had a man at a local garage weld together a chamber into which he pumped carbon dioxide and traces of oxygen. The temperature was kept

low by immersing the chamber in a refrigerant bath. A vacuum pump lowered the air pressure, and an ultraviolet lamp simulated sunrays unfiltered by a thick atmosphere.

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"I killed the slime mold," he reports 30 years later.

Despite that, McCleese is the chief scientist for JPL's Mars Exploration Program, setting the strategy for an ambitious series of Mars missions that began with Pathfinder and Mars Global Surveyor.

"We'll be going back every 26 months, each time Mars is at its optimum position with respect to Earth," he said. Pairs of spacecraft—one with an orbiter, the other with a lander—will be launched on separate rockets to the red planet. Besides carrying their own scientific equipment, the orbiters will act as relay stations transmitting data back to Earth from the landers.

- Late 1998–early '99: Mars Climate Orbiter will carry cameras and equipment to study the atmosphere and the surface. Mars Polar Lander will settle near Mars's southern ice cap—thought to be frozen water and carbon dioxide—and take samples with a robotic arm. Two small probes will be dropped into the ground to search for water. No rover will be included.
- March 1999: Mars Global Surveyor will attain a circular orbit over Mars's poles. Capable of imaging objects the size of a large desk, it will map the Martian surface. Other instruments will continue to study Mars's localized magnetic fields. A laser altimeter will measure, to an accuracy within a meter, seasonal changes in the height of the ice caps.
- 2001: The new millennium begins with the launch of a new orbiter and a lander, ideally with a rover payload. Considerably hardier than the fragile Sojourner, the 2001 rover will collect rocks and soil samples and cache them. Scientists will select the landing site based on high-definition data collected by Mars Global Surveyor and Mars Climate Orbiter.
- 2003: As in the 2001 mission, this lander will be sent to an area with rocks most likely to bear evidence of past life on Mars. Again, the rover will collect and cache rocks and soil samples.
- 2005: The first round-trip mission to collect rocks. Using technology not yet developed, a lander will head for the most promising of

the previous landing sites. Its rover will collect the rocks and soil samples cached by an old rover. Samples will be brought back to Earth in 2008 for detailed study.

"I plan to be here through all the planned missions and for subsequent sample-return missions as well," said McCleese. "We really don't believe a single sampling will tell us everything we need to know about Mars."

Already completing his camera for Mars Polar Lander, Peter Smith both revels in his work and longs for something more. Wearing a pair of blue-and-red 3-D glasses, he studied a stereo panorama of Mars mounted on a wall of the JPL auditorium.

"If I have a regret, it's that we lost Pathfinder just before the Martian dust storm season," he said. "I tell you, I would have loved to see a big old cloud of dust roiling up from that horizon. It would have been like the Dust Bowl, only a whole lot bigger, covering the entire planet."

And, presumably, louder. Perhaps we'll find out in 1999, when Mars Polar Lander settles in near the South Pole—with a microphone on board.

Smith stepped closer to the mural for a look at the panorama's most distinctive features, two hills he named Twin Peaks.

"They're a half mile away, and we couldn't get there with the rover. But our nextgeneration rover will be able to drive beyond the horizon, leaving the lander behind.

"We can't afford to launch a heavy rover that can drive hundreds of miles, however, so the irony is that when you go to Mars cheaper and faster, it actually takes longer to really explore it. I'd love to see a Mars program that would get humans there in our lifetime."

In a fit of optimism, then President George Bush suggested that the U.S. should land humans on Mars by 2019, the 50th anniversary of Neil Armstrong's first step on the moon. As the years pass, that possibility seems to dwindle. But just imagine the year 2008. The sample mission comes back with a rock that bears evidence of fossil remains.

There may have been life on Mars. The only way to know for sure would be to go look.

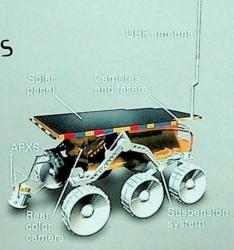
We'd still have eleven years. We got to the moon in less than ten.

Learn more about the Mars Pathfinder mission at www.nationalgeographic.com/features/98/mars.



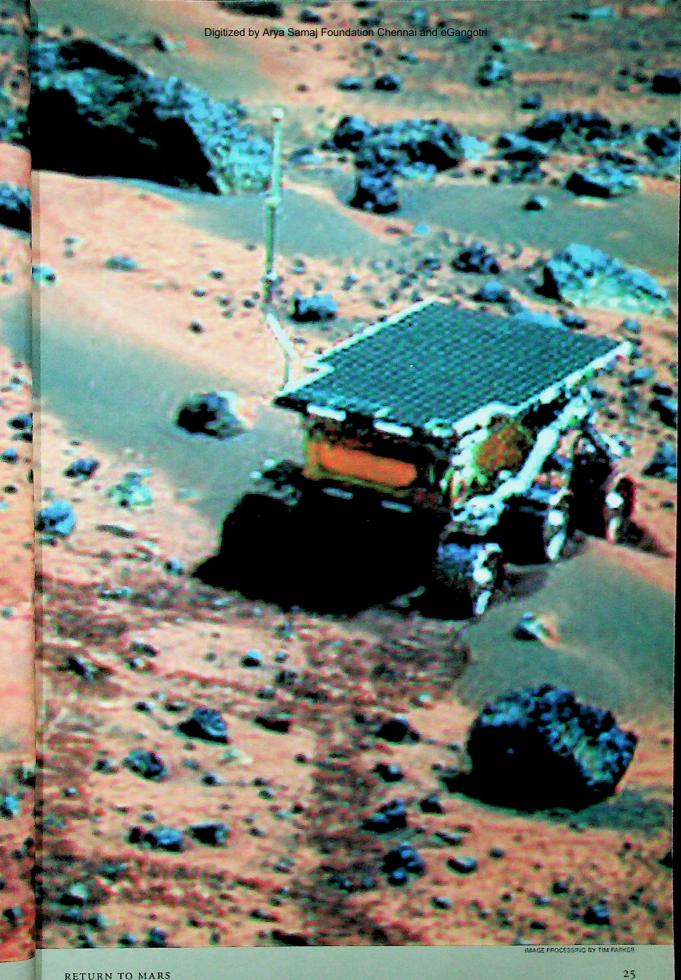
Sojourner goes six wheeling

Think of a microwave oven and you've pictured the size of the rover named for abolitionist Sojourner Truth. Two feet long and a foot tall, it was designed to give "ground truth" on its Mars sojourn, surface data to be



used for interpreting information gathered by subsequent Mars orbiters. It captured close-up images of the terrain and a view of the lander itself (top). A 25-million-dollar interplanetary geologist with stereo vision and an alpha proton x-ray spectrometer (APXS) to analyze rocks and soil, Sojourner was designed to surmount obstacles seven inches tall. Encountering an eleven-inch-tall rock called Wedge, the rover (below, from rear) sensed trouble and stopped to await instructions from Earth. It was facing the camera when it ended a day on Mermaid Dune (right).





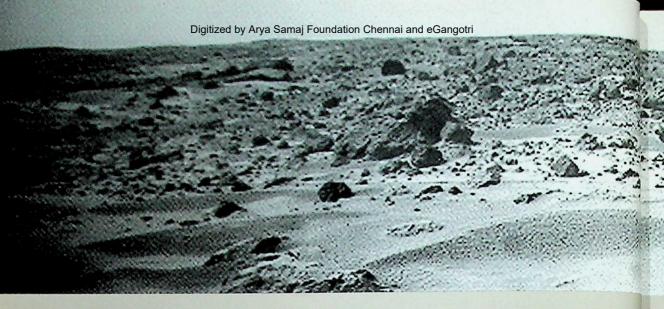




CHECKING OUT CHIMP, the rover cozied up to the whimsically named rock, perhaps volcanic, to photograph its cracked, pitted face (above). A dark crust seems to cover

much of its surface. At Moe (far left and left), Sojourner saw flutes that indicate wind erosion and extended its APXS sensor to try to determine chemical makeup

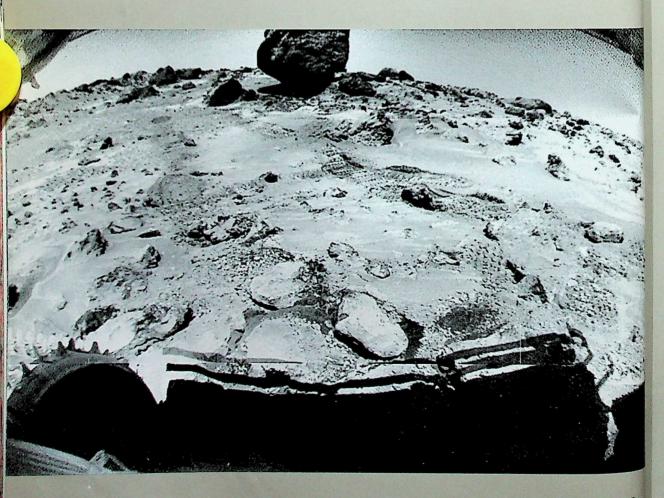
Data are still being analyzed, but the rocks at the landing site generally show elevated silicon levels, suggesting an unexpectedly Earthlike composition.

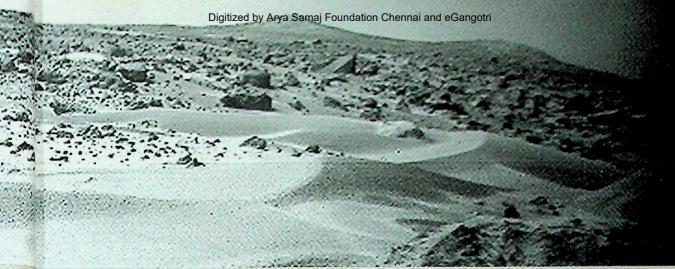


LOOKING OVER A RIDGE beyond the Rock Garden, Sojourner saw dune forms (above) out of sight of the lander's camera. About half a foot high and a yard long, they are crescent-shaped, or barchanoid, dunes, common on both Earth and Mars. Their

horns point downwind and here show prevailing winds from the northeast.

From its low perspective, the rover could see the balancing act of three-foot-wide Yogi (below), the largest boulder it studied, probably deposited in





MACE PROCESSING BY THE PARKER (RELOW)

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Five-inch-high Flat Top (below) has elongated pits either of volcanic origin or caused by weathering. The top is coated with dust, which in mild Martian winds also accumulated on the lander and rover. After the trip on which it saw the barchanoid dune forms, Sojourner was to circle back around the lander, then take readings with its APXS of the dust particles that had been drawn to the lander's ramp magnets. But the lander, which relayed

all rover findings, sent its last data transmission on September 27. JPL twice revived contact but learned nothing. Intermittent attempts were made until March, when the Pathfinder Mission was officially declared over.



RETURN TO MARS

Deep in Borneo, a male orangutan we call Jari Manis feeds on wild ginger stems as he keeps an eye on a female he's been shadowing. My team of assistants and I track the clusive apes from dawn to dusk, when they bed down in a nest in the trees (following pages). Mixing modern science with old-fashioned fieldwork, we are breaking new ground in understanding how wild orangutans have adapted to their rain forest home.

ORANGE INTHEWILD

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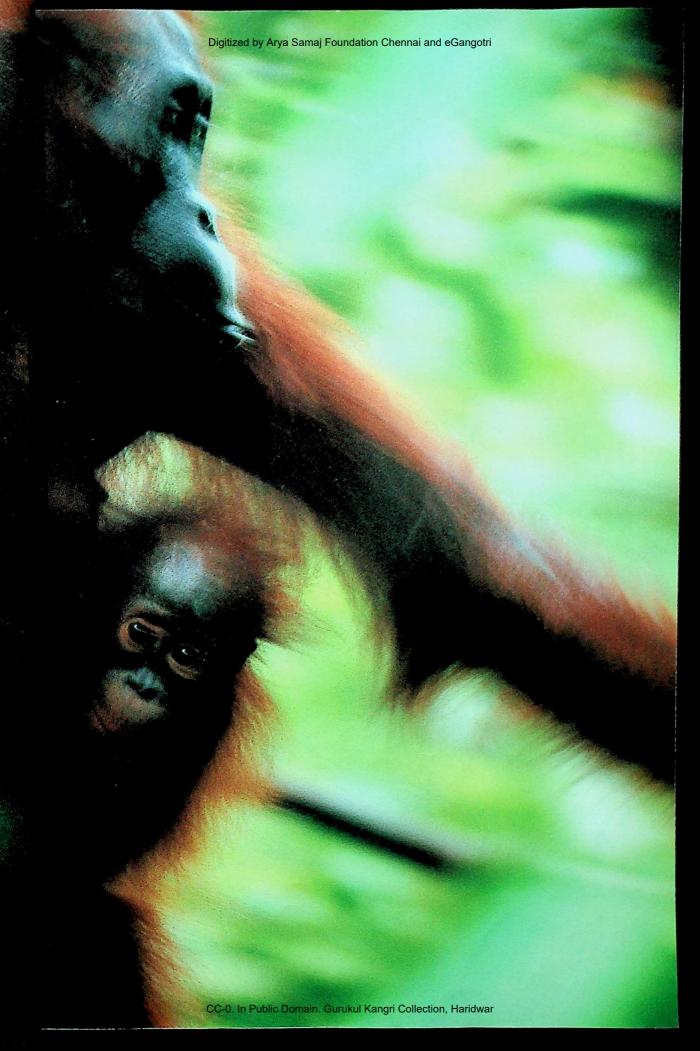
By CHERYL KNOTT

Photographs by TIM LAMAN

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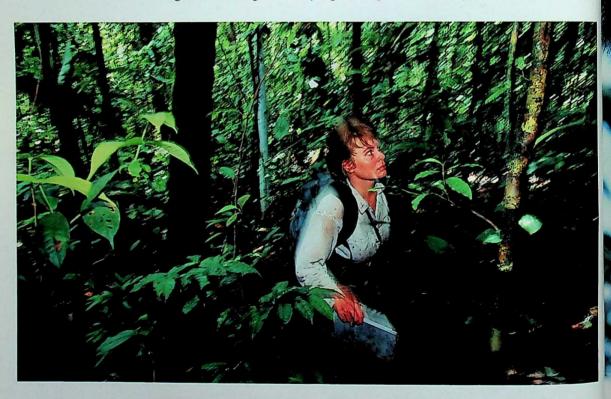
n darkness, submerged in water up to my neck, I was plunging through a flooded creek, a creek that I had easily jumped over that morning. My husband, Tim, was wading along just a few feet ahead of me, while balancing a backpack full of camera gear on his head. He turned and said, "Are we in Borneo, or what?"

We were slogging our way back from a full day of following a wild orangutan as she searched for food on the rain-drenched mountain slopes of Indonesia's

RESEARCH PROJECT

Supported in part by your Society Gunung Palung National Park, near the west coast of Borneo (map, page 38). We had made a research site there our home. Tim was continuing his studies on the animal and plant life high in the rain forest canopy, and I had begun my investigation of wild orangutans. For several months we had been following an adult female we had named Beth, and she was now well past the stage of vocalizing and dropping branches on us,

behavior typical of orangutans when they first encounter people. These large red apes can be surprisingly difficult to find and follow. Like fat-bellied acrobats, they seem to traverse the canopy effortlessly, leaving researchers such as me to crash through the undergrowth trying to keep a constant eye on them (below).



The year before, we had made the trip upriver to the research site in the middle of an unusually severe dry season. The water was too low to use a boat with a motor, so we had to drag our dugout canoes, burdened with more than a year's worth of research supplies, across the sandy river bottom. As we penetrated farther and farther into the forest, a steady stream of white and pink flowers floated down to greet us as if we were in a ticker tape parade. The flowers heralded a so-called mast fruiting—an event in Southeast Asia rain forests when a large proportion of trees bear fruit at the same time. The mast provides a boon for orangutans, like Roman (right), who gorge themselves on high-calorie fruits. The sun's last rays turn mist into a flaming yellow blanket, tucking the rain

mid-with a ear's ser-en a coon fruits.

т 1998



forest in for the night (right). Lush and teeming with life, this botanical wonder leads many to think of it as a virtual Garden of Eden that produces an unceasing cornucopia of succulent fruits. In reality, though, fruit abundance varies greatly even if temperature varies little.

Periods of high fruit production happen only at odd intervals in Borneo, about once every four to seven years, although smaller fruit peaks

occur every year. Being there during a mast fruiting proved ideal for studying how changes in food abundance influence orangutan reproduction and behavior.

Unlike chimpanzees, for example, orangutans do not live in groups. Adult males travel alone, and mothers are usually accompanied only by an infant and sometimes by an older juvenile.

This is partly because the fruits that the animals prefer are

widely dispersed and can't support large gatherings of the apes.

But orangutans are not wholly unsociable. During the mast we've seen as many as eight individuals feeding together in the huge dipterocarp trees that dominate the rain forest. Clearly orangutans get together when the food supply permits.

I spend countless hours sitting on soggy ground observing the animals. One day I watch

Research and Exploration.

Roman eat one after another of the pineapple-size durian fruits. Hearing a rustle, I turn and see Rob, a subadult male, throw together a nest in a tree behind me and dive in. Rob lacks the cheek pads and throat sac of fully mature males like Roman and doesn't announce his presence with long, bellowing calls. He eyes Roman and the durian tree. When Roman has eaten his fill, he guits the tree, ignoring Rob as the smaller ape approaches to feed. After gorging on durians, Rob pauses at a small Baccaurea tree to grab a handful of its glossy red fruit (right).

When he leaves, one of my assistants shinnies up the tree to take some fruit for us to weigh and dry out. I pick up some loose durians that Roman and Rob have knocked down. Later in the laboratory I'll be able to figure out how many calories they have consumed today.

I spread plastic sheets beneath animals sleeping in their tree nests to collect urine to analyze for hormones and signs of disease. In bringing such scientific

techniques into the forest, my goal is to gain a deeper understanding of orangutans without intruding on their life in the wild. In 1997 Harvard University anthropologist CHERYL KNOTT and her husband, Harvard biologist TIM LAMAN, received the first annual Chairman's Award from the Society's Committee for

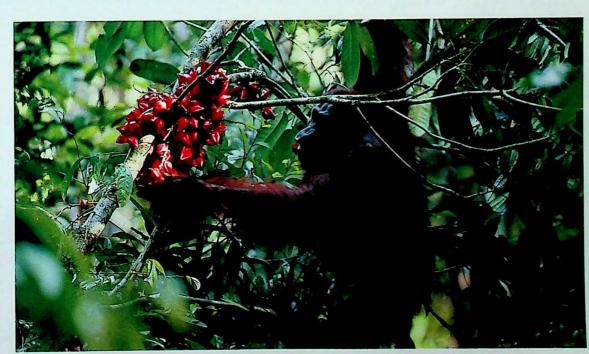




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NG MAPS





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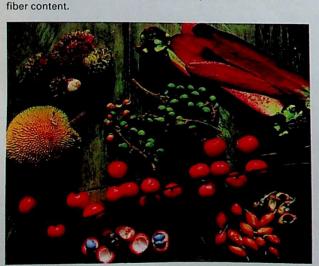
Boom or Bust

The research site in Gunung Palung National Park covers eight square miles of rain forest, and a grid of trails (dashed lines) permits quick access to the varied habitats occupied by orangutans. My dedicated team of Indonesian and Western assistants and I have logged more than 15,000 hours observing the apes. Their movements are highly influenced by the presence of ripe fruit. Depicted on the map are the paths of five orangutans observed during sample periods, with dots marking the places where each slept at night. During the mast fruiting, orangutans were found mostly in the alluvial terraces and lowland hills, where dipterocarp seeds, durians, and other fruits were abundant. During fruit-poor periods the apes often ranged more widely between habitats while searching for food. Recording such travel helps us develop a clearer picture of the complicated orangutan social system and the way each animal's home range relates to others. This approach has, for example, led to the finding that as many as six adult males may range independently over a given area at the same time—a surprising degree of territory overlap.

Peat swamp

In flat, poorly drained areas with sandy soil, organic material builds up on the forest floor, and tannins tint the water red. This forest is host to important orangutan fruit trees, such as Palaquium leiocarpum (foreground) with its stiltlike roots.

> able, orangutans rely on less nutritious but relatively plentiful foods, such as leaves, figs, ginger stems, and the inner layer 0 bark. Low-fruit periods can last for months.



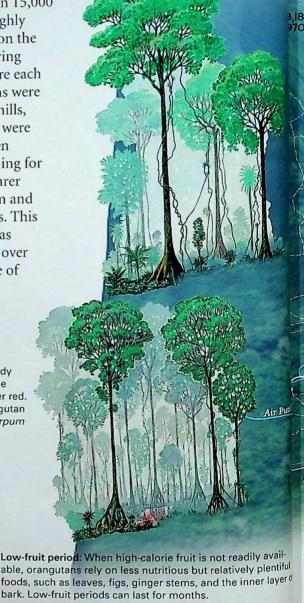
High-fruit period: An orangutan's diet during a mast fruiting

is higher in calories than at other times. My research has

shown that this is due to a higher carbohydrate and lower

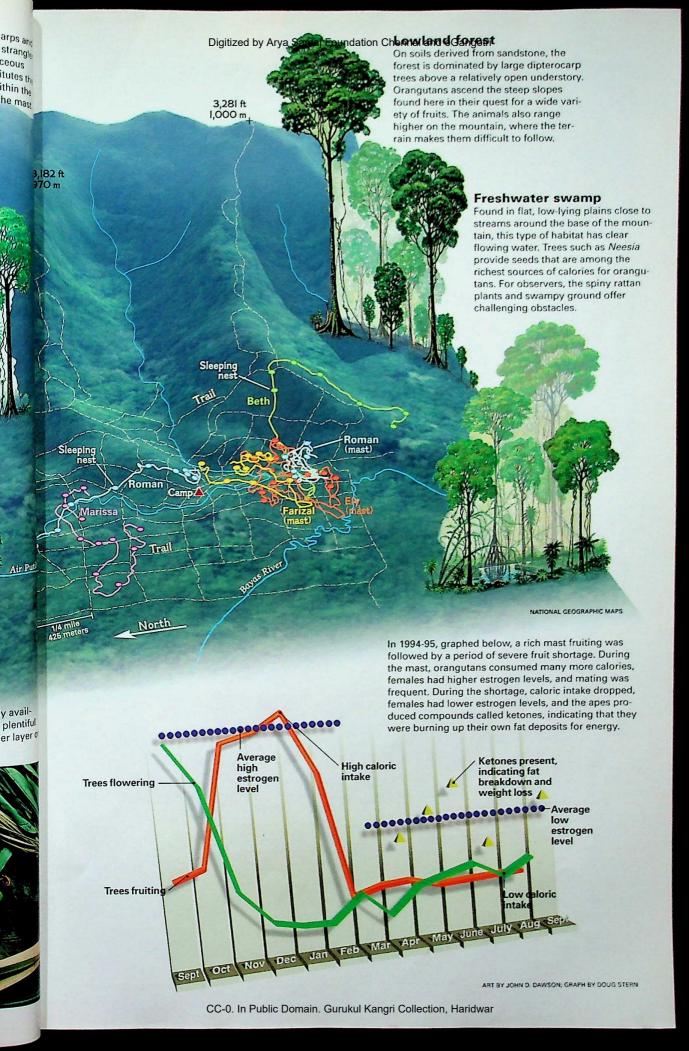


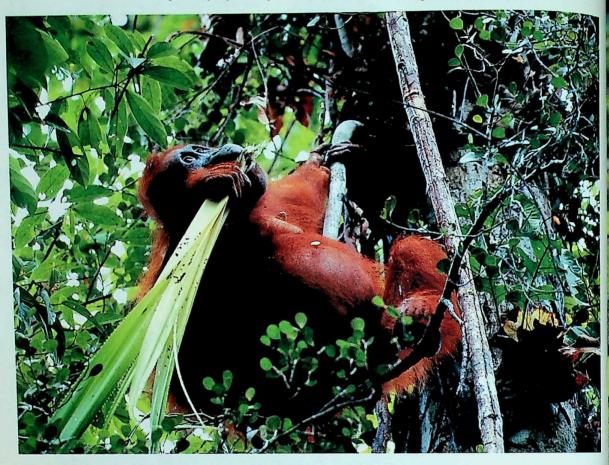
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the highest density of vines and strangle fig trees, as well as a lush herbaceous layer at ground level. This constitutes the richest habitat for orangutans within the

research site, especially during the mass





When Times Are Lean

poing a little jungle gymnastics, young Misha hangs by one arm (facing page), peeling ribbons of bark from the tree as her mother, the upsidedown Marissa, does the same.

After several months of superhigh fruit production the forest now offers slim pickings, and orangutans scramble to find enough to eat. Males sometimes journey to the forest floor (though females rarely do); Jari Manis descends to the ground to suck termites from their nest (right).

Though they now have to turn to low-quality fruit and vegetation such as bark, leaves, or the celery-like *Pandanus* that Beth (above) has broken off, they make do.

Such periods of abundance and scarcity have helped shape orangutan evolution. As with humans, orangutans store fat when food is abundant. By measuring the byproducts in their urine, I've

found that during periods of scarcity they produce ketones—telling me that they are burning up their fat deposits. The extra calories they stored when fruit was plentiful are now helping them survive.

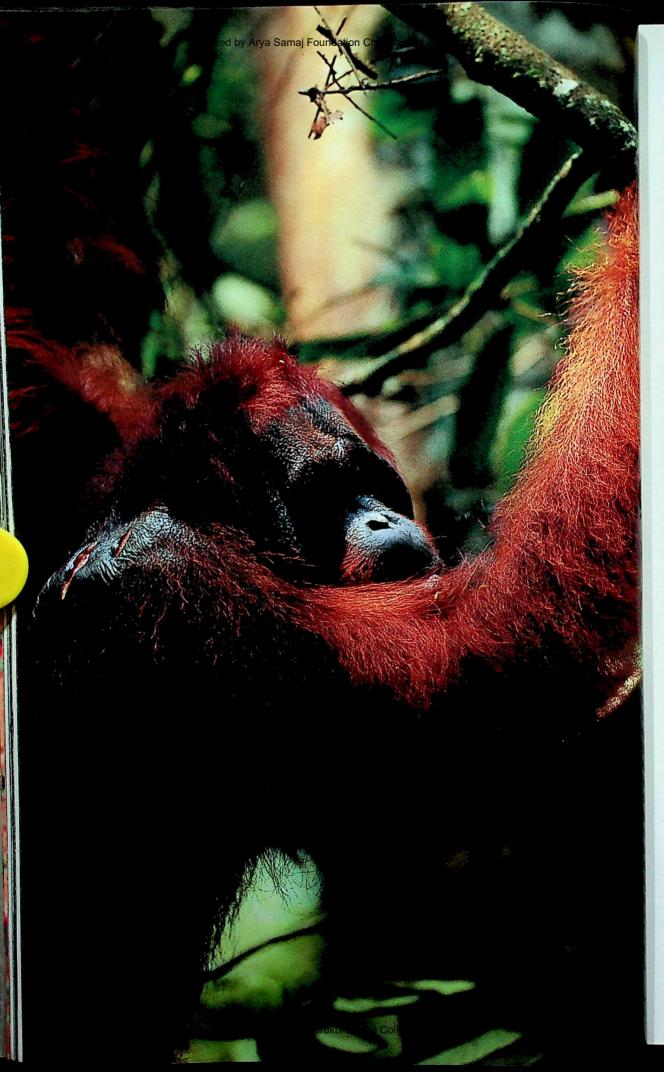


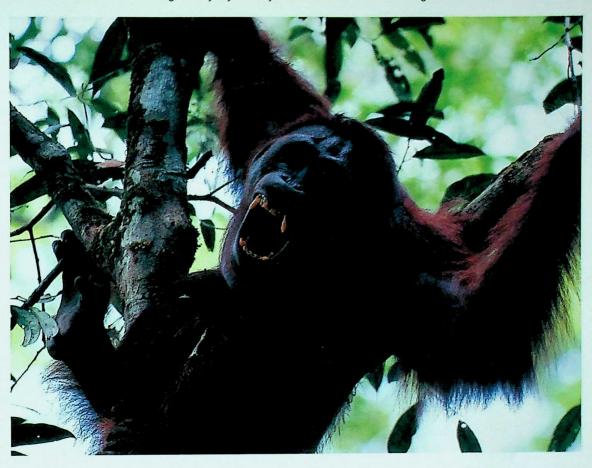


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Conflict Between Males

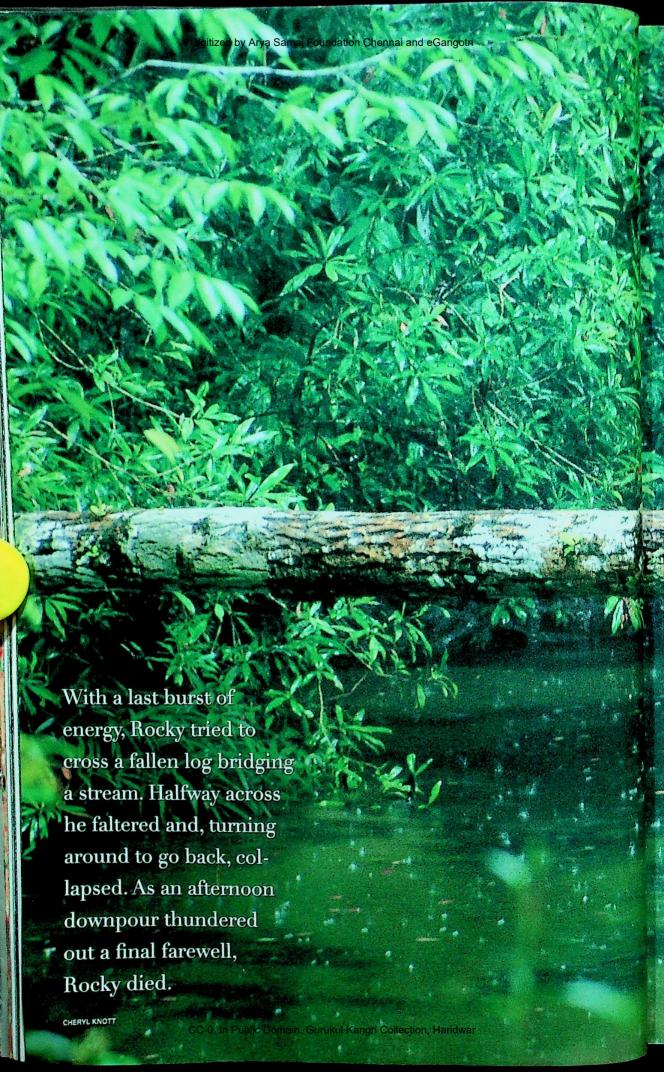
hen we came upon Rocky (left) on the forest floor one day, we saw new gashes on his right shoulder. His wounds could have been made only by another male's canine teeth, like those displayed by Rob (above), in the infrequent but sometimes deadly fights between males. Several weeks later when I was following Rob, I came upon Rocky again. He had become severely emaciated and was in no shape for an encounter with Rob. The two grappled and rolled on the ground until Rob finally left, leaving Rocky even further exhausted.

The next morning we found Rocky curled in a ball on his side, his matted hair

giving little cover to his protruding ribs. Around midday he managed to shuffle over to a small tree, where he grabbed a handful of fruit

and collapsed again, slowly chewing without lifting his head from the ground (below). Sadly, I knew that he didn't have long to live.







e placed Rocky's body on a crude wood-and-wire frame and hoisted him up for his last trip into the canopy. I hoped that this would keep scavengers, like Borneo's bearded pigs, from scattering his bones, which I wanted to study for signs of disease and injury. Two weeks later we were amazed to see Rocky's clean white skeleton laid out on a bed of stringy red hair (right). Later I finished the job that the insects had started (bottom left).

So far as I know, such an orangutan death had never before been seen in the wild. Given the apes' low population densities and long lives, the probability of witnessing a death is extremely low. Even so, Rocky's remains were joined a few months later by those of another adult male (bottom right, at right), found in a streambed.

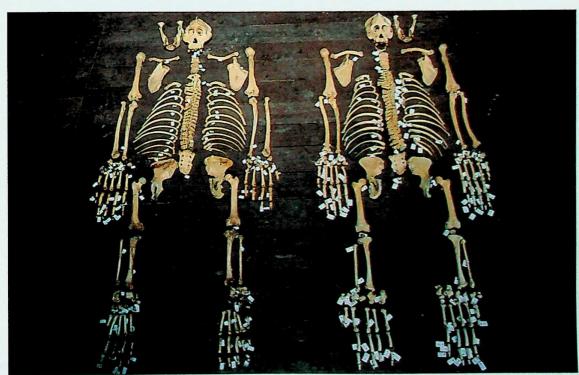
These rare finds were most likely the result of an increase in male conflicts arising from the influx of orangutans drawn to feast on the abundant fruit. We had seen as many as six large-and mutually intolerant—adult males ranging within a small region. Here was natural selection at work: Countless contests between adult males during orangutan evolution likely contributed to males being twice the size of females.

The battle between males to mate has reproductive payoffs but is not without cost. Testing urine samples, I have detected significant signs of infection resulting from wounds that can, as in Rocky's case, lead to death.

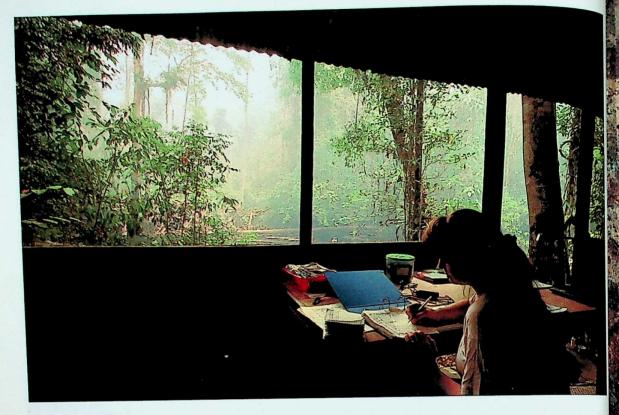


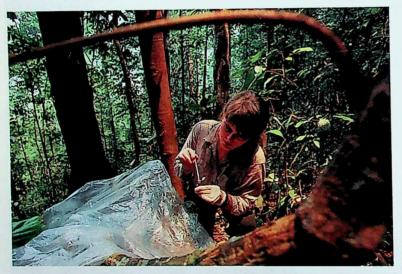






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Field Data

hen the apes turn in early, our open stilt house (above) provides a retreat to review the day's data. At dawn I am back on the forest floor, collecting urine (left) from an orangutan just awakening in her nest above. I can test the urine on site for signs of menstruation, infection, and weight loss (bottom left).

I save some samples for later genetic analysis, so I can learn who is fathering off-spring and how the animals are related. I'll also analyze the hormones in the urine back at the lab.

By measuring hormones for the first time in wild orangutans, I've found that estrogen levels increase when nutritional status improves. Pregnant Beth (right) conceived her baby Bekti during the mast fruiting, when estrogen levels were high.



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Growing Up Slowly

to Tim in my astonishment. The young ape bites off the rat's head and swings it by the tail like a stuffed toy (above).

Orangutans rarely eat

meat, and in this case Misha seems motivated more by curiosity than by appetite. She also occupies herself with the orangutan version of playing house (below), making a simple nest and

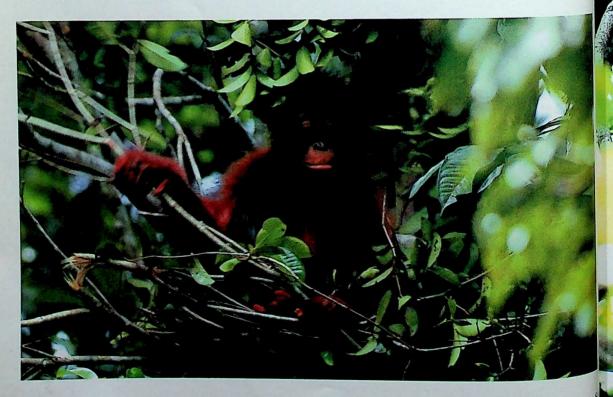
practicing the skills of independent living she'll need when Marissa, her mother, one day turns her attention to a newborn.

The pioneering work of Biruté Galdikas suggests that orangutans bear offspring only once every eight years on average—an extremely long interval among mammals.

After a mother gives birth, her baby will cling to her for several years, rarely venturing away from her side, and continue to nurse for about six years. A juvenile sibling may stay with its mother for a few years, as does Emy (right, at bottom) with mother Ely and her infant.

Emy is learning how to fend for herself since, unlike human mothers, orangutans normally do not provide food for their offspring beyond lactation.

One of my research goals is to try to determine why these periods of juvenile dependency last so long.



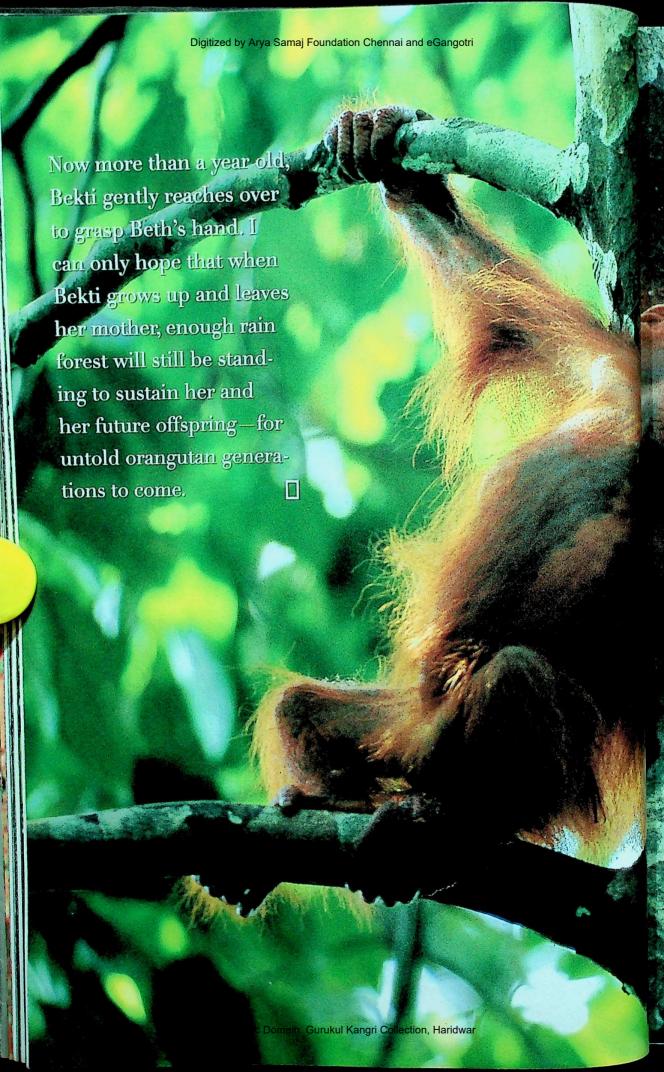
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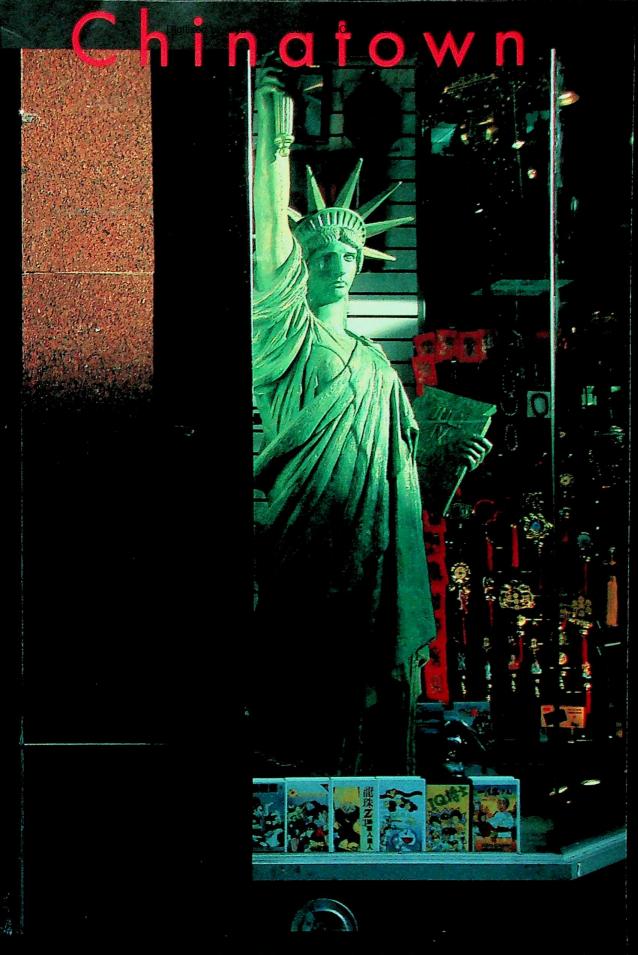




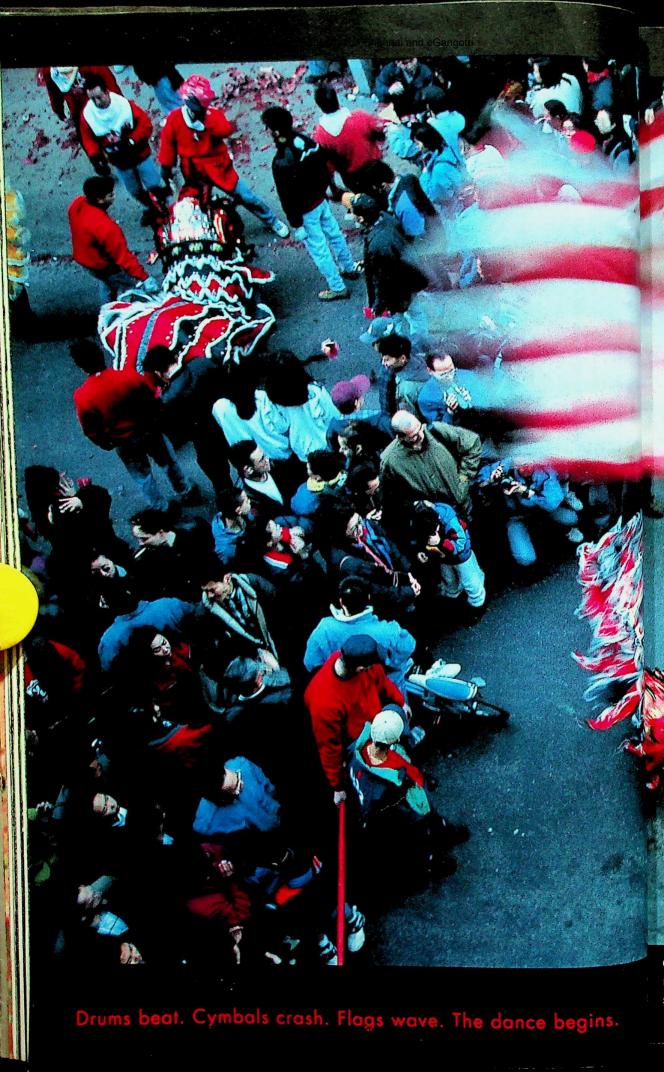
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Yearning to breathe free, a new wave of Chinese immigra



ours into Manhattan seeking liberty and a fresh start.





On the prowl during a Chinese New Year parade, a yellow lion with white "hair" (symbolizing the wisdom of old age) confronts a youthful rival. "To look like lions," says a middle-aged resident, "they should wear black kung fu pants, not dungarees!"

By Joel L. Swerdlow

ASSISTANT EDITOR

Photographs by Chien-Chi Chang

UESTS TAP CHOPSTICKS
on teacups as the young
couple lean closer to
kiss. The bride, Feng
Jheng, is 21 and sews
garments in a sweatshop. The groom, TianLi Li, is 28 and head

cook in a restaurant. Her fingers rest on his shoulder. The crowd, totaling nearly 200, cheers as their lips touch.

Cheers also come from three other wedding celebrations in the Silver Palace, one of the largest restaurants in New York City's Chinatown. Waiters push trolleys of shrimp, noodles, and meatballs past tables with plates of oranges and watermelon seeds. The rug, tablecloths, wall hangings, napkins, streamers, bride's dress, and groom's boutonniere are red, a symbol of luck in Chinese tradition.

All the newlywed couples celebrating today are recent immigrants—eight men and women out of a quarter million Chinese now living or working in Manhattan's Chinatown. With thousands more living nearby in Queens and Brooklyn, Chinese constitute more than 3 percent of New York City's population and are one of the city's fastest growing ethnic groups—the largest concentration of expatriate Chinese outside Southeast Asia. About 12,000 arrive here legally each year. Just as many may come in illegally.

I have come to Chinatown to get a sense of a place that seems like a foreign country, full of energy and exotic language. With the exception of groups from tour buses around Mott Street, traditionally the center of Chinatown, almost everyone is speaking Chinese. Signs are in Chinese, and newsstands sell only Chinese-language newspapers. People crowd around pushcarts selling fried taro root and scallion pancakes. Roasted pigs and ducks hang glistening in restaurant windows.

Most residents live in crowded tenements.

Freelance photographer Chien-Chi Chang, a native of Taiwan, now works out of Baltimore, Maryland. This is his first story for the magazine.

But Chinatown also has a few high-rise apart, ments, occupied mostly by middle-class and retired people, and blocks of renovated town houses with three-story atriums.

Until the 1980s, when China began to east emigration restrictions, Chinatown covered about a dozen blocks in lower Manhattar dominated by restaurants and curio shops (map, page 64). Today it sprawls halfway across Manhattan, occupying approximately six time its original area and, in the process, swallowing large sections of some older neighborhood around it. To the north Little Italy has shrunt to a few shops and two blocks of restaurants

Chinatown has rolled over the edge of the Lower East Side, traditionally the immigrant beachhead and the home of European Jews. The head of a yeshiva, a Jewish school, plead with me not to refer to her block as Chinatown I look around. Everyone else on the sidewall is Chinese. A man selling kosher pickles nearly laments, "The Chinese are buying everything and he didn't mean pickles.

I pause to wonder what sense my grand-parents—Osias and Ethel Katz—would have made of it all. They came to the Lower East Side from Eastern Europe around the turn of the century, met through a matchmaker, and were married in a social hall that is now a Chinese apartment building.

"Does Chinatown have matchmakers?" I as Zan Ng, who came here in 1975 from China's southeast coast. We are walking along Eas Broadway, one of Chinatown's main thorough fares. Newcomers call East Broadway "Little Fuzhou," after the capital of Fujian, the province from which many of them emigrated.

"There's a matchmaker," Zan says, pointing to a sign in a third-floor window. Most of the newcomers here are single males. Indeed, some villages in Fujian Province have lost more that half their population to the United States and are now virtually devoid of working-age men

At a sidewalk food stand Zan introduces in to lotus roots and sweet pancakes with peanly filler. "This is Fuzhounese food," he says. "If were on a street that had people from norther



China, we'd be seeing sweet rice cakes, dumplings, and steamed buns."

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Zan was born in rural Fujian Province and dropped out of school at age seven. At 18 he entered the U.S. without

proper papers and was jailed briefly but then released. Zan got his first job in a restaurant washing dishes. He taught himself to read Chinese and to speak and read English. Now he owns an advertising agency, a telemarketing firm, and several other businesses, employing more than 200 people.

"How did you do it?" I ask as Zan fields calls on his cell phone. We are sitting in a restaurant on East Broadway, snacking on duck tongue.

"How did I make it here? Hard work, saving, and keeping an eye out for opportunity," he says. "That's how you do it. Then something comes along." He reminds me that Chinatown has more banks per block than

SWEARING IN He who takes the oath as president of the Chinese Consolidated Benevolent Association becomes the unofficial leader of a community that isn't consolidated at all. But despite their regional and ideological differences, most residents of Chinatown can gaze at a portrait of Sun Yat-sen and see a hero who helped dethrone China's last emperor.

any other section of New York City and that these banks often have lines of people waiting to make deposits. "The banks are open on Sundays too," he says.

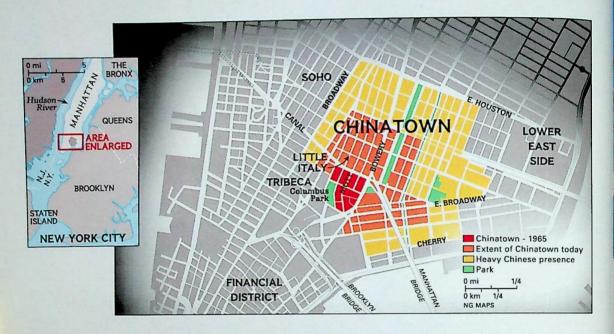
For the newcomer from China who wants to rise above poverty, it seems to me that the necessary first step is to learn English. On a door in a small shopping arcade I see a sign advertising English lessons. I knock and go in. A man greets me. He's surprised to see a Caucasian but motions toward a seat and offers me tea.

We are alone in a windowless room with a desk, a chalkboard, 12 classroom seats, a sink, and a hot plate. The man says he is 57 years old and was a professor of English at a major

NEW YORK'S CHINATOWN

TIGHT QUARTERS

Of the thousands of legal and illegal Chinese immigrants who arrive in New York City each year, many come from mainland China's Fujian Province and settle along East Broadway in "Little Fuzhou" (right). Signs of the time—for a marriage broker, a florist, a real estate agent, a driving school—reflect a local Chinese population that has quadrupled in the past 30 years.



Chinese university. In 1989 he helped dissident students at Tiananmen Square communicate with Western journalists. After the killings there, he came to the U.S. He does some translating for courts and immigration hearings, teaches English classes here, and sleeps on a cot behind a curtain. He says he is ashamed of how he lives and asks that I keep his name secret. So I call him Teacher. He invites me to meet some of his friends that evening at a dance hall.

The dance hall is up three flights of stairs above some shops. On the dance floor the 20-or-so regulars fox-trot under swirling lights as Hong Kong soap opera music blasts from speakers. Most of the dancers seem to be Teacher's age. They live in Brooklyn or Queens. Some are accountants or beauty technicians. A few are unemployed. They come to Chinatown to escape loneliness, to meet other Chinese people, to eat the best Chinese food, to remind themselves of where they came from. "It's fine to be young and in Chinatown," one tells me. "But if you're not young, life here is too hard. You have to work too long for too little money."

The next afternoon I meet five students in Teacher's "restaurant English" class.

The students repeat "A, E, I, O, U" and do drills: "We, he, be, me, she; bike, like, big, pig."

I sit in the back thinking this should be easy, until Teacher, perhaps reading my mind, asks me to repeat some Chinese words. My mouth becomes knotted. I try again. Nothing comes out. The students smile sympathetically.

OR A CENTURY and a half this part of lower Manhattan has functioned as a catchment for successive waves of poor immigrants, including Irish, Germans, Italians, East European Jews. Each enclave dissolved as second and third generations seized the opportunities that education afforded them and then moved on to better neighborhoods, greener suburbs, or distant cities. But lower Manhattan, with its inexpensive housing, remained, ready to absorb the next wave.

The Chinese of Chinatown fit this pattern but might also break it. Most of them are Cantonese speakers who have lived here for several generations. China also harbors a supply of potential emigrants that appears virtually unlimited. And they will keep coming as long as the most common jobs in Chinatown, restaurant and garment workers, require neither a command of the English language nor, as far as the boss is concerned, proof of legal status.

To a greater degree (Continued on page 71)

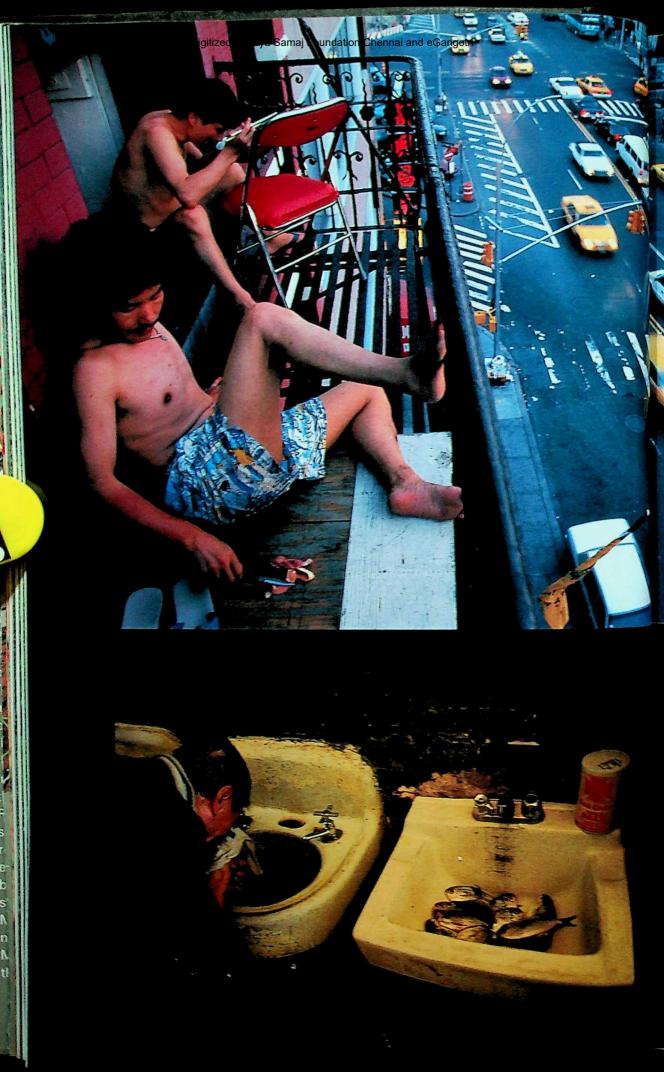
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Trying to fit in

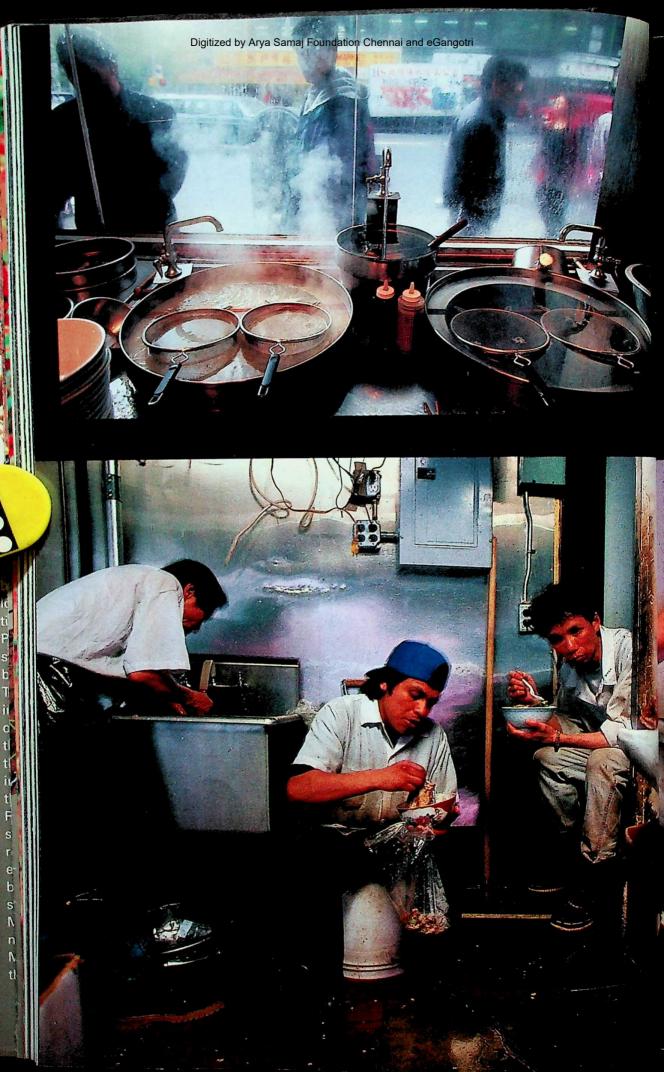
Upon arrival in New York many immigrants can afford to live only in dilapidated, cockroach-infested boardinghouses like this one a few floors above Bowery. For \$150 a month, a tenant gets his own bunk bed in a tiny room he shares with perhaps three others. Many of the men-and they are all men-make room for a TV, their window on America. Down the hall are two showers, four toilets, and three sinks that serve several functions for 100-plus residents. Nevertheless, says Paul Lee, a local merchant: "You want to meet a billion people who'd like to live in the United States? Go to China. At least here we have toilets that flush."







Trying to deal himself a better hand, this 50-year-old man bid his family in Fujian Province good-bye ten years ago and left for the U.S. Today he remodels Chinese restaurants. "I dream of bringing my wife and children over here," he says, "and opening my own restaurant."



STEAMED UP

Low-paying restaurant jobs sustain large numbers of immigrants. Many of them work grueling hours, stopping to grab a bite to eat when time permits. Their strong work ethic is fueled by a hunger to escape poverty and, for many, by a crippling load of debt. To reach the U.S., some recent arrivals promised as much as \$35,000 to smugglers, called snakeheads, who don't hesitate to use intimidation and violence to exact payment in full.



(Continued from page 64) than for their European predecessors in these tenements, assimilation is difficult for the Chinese. "No matter what we achieve and where we live, people still see us as Chinese," one businessman tells me. Their ethnic pride is rooted in a continuous culture 4,000 years old. Except for the past few hundred years, China was the world's most technologically advanced culture. Everyone I meet, even Chinatown's poorest, uses the same word for white people. It means "barbarian."

Cultural pride is evident in Chinese Americans who live among non-Chinese neighbors throughout the metropolitan area but come back to Chinatown on weekends to give their children what they call "a Chinese experience."

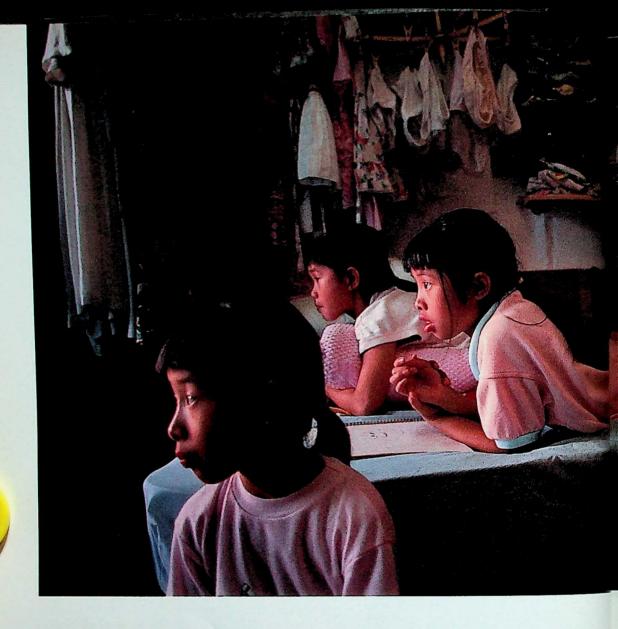
"It's like going back to mom's house," one woman explains. "It's nostalgic. You go even if you don't need anything, and you always pick up something that reminds you of home."

Chinatown also attracts young adults who don't speak Chinese but feel drawn for reasons they can hardly articulate. "Only a Chinese person can cut my hair," says a young Chinese American who lives in Connecticut but whose barber works in Chinatown. Residents of Chinatown describe these visitors as ABCs—American-born Chinese—or as bananas, yellow on the outside and white on the inside.

The ABCs often sound defensive. "It's not a crime to be Chinese and not speak Chinese," one young woman shouts at a street vendor who's frustrated that she speaks only English.

To keep their sense of the mother culture strong, some ABC parents send their children to Chinese-language, or "Saturday," schools in Chinatown. Others bring their children to Chinatown's public schools from other parts of New York. One afternoon I wait with parents as they pick up their kids after school. They are middle-class professionals. "We never lived in Chinatown," one mother tells me. "I just want my daughter to know what it's like to be in an environment with Chinese people."

photographer Chien-Chi Chang. He is from Taiwan and has been living in Chinatown with illegal immigrants for about six weeks. I ask if I can visit where he sleeps. He is apologetic but firm: This might jeopardize the trust he has earned. I can come only when he has finished taking photographs.



Late one evening, more than a month later, Chien-Chi takes me to a large building on Bowery, one of Chinatown's busiest streets. On the second floor we pass the locked doors of a Buddhist shrine. "You will not be reincarnated for 10,000 years if you steal from the temple," warns a sign in handwritten Chinese.

On the fourth floor, where Chien-Chi has been living, the smell of urine mixes with the odor of food cooking. Plywood partitions separate sleeping platforms stacked as in a submarine. Exposed lightbulbs dangle from the ceiling. The walls are covered with hooks for hanging clothes and photographs of families.

One man tells me, via Chien-Chi, that he is happy to have a construction job in New Jersey. It pays ten dollars an hour, most of which he sends to his family in China. In a 40-hour week he earns more than the average yearly income of a person in his home village.

"What if you're hurt?" I ask, thinking that

he'll laugh at my American softness. After all, he's young and looks quite strong.

The man lifts up his sleeve and shows me where an accident at work broke his wrist. He received no medical care. He pulls up his pants leg. Open sores from a work-related accident cover one ankle. He says it always hurts.

"When I'm here, my heart is in China," he tells me. He has a telephone in his cubicle which he uses to call his family in Fujian; his monthly telephone bill can total more than his monthly bill for food.

Despite their discomfort and longing for home, the men crowding around us still see America as a place of hope, the "golden mountain" where dreams come true. When I talk about how hard life must be and ask why the don't return to China, they protest. "I know I can succeed, so there's no need to go back, one man assures me. "This is much better," say another man. "In my village there is no work."

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LOOKING AHEAD If their parents have their way, Lily, Mary, and Amy Lam will not grow up to become garment workers like their mother. Though many needle-and-thread workers toil in union shops (below), they remain hesitant about demanding their legal rights, largely out of fear of losing their jobs and benefits.



federal prosecutor told me. "But now we have these new international crime syndicates. Cracking them is much harder." With major centers in New York, Los Angeles, Atlanta, Chicago, and San Francisco, the new syndicates enjoy ties to crime families in Taiwan and China.

According to law enforcement officials, most smuggled immigrants come from Fujian Province. Their journey begins with a down payment; the snakeheads demand around \$1,500. Then there is the trip, usually by freighter, which can take four months and include stays in Latin America, Russia, or other jurisdictions with lax visa requirements. Officials say physical abuse, disease, and inadequate food or water kill some of these people the snakeheads call customers. Customers often enter the U.S. across the Canadian or Mexican borders.

Once in New York, customers telephone their families in China. The family then pays the balance to local "snaketails." Treatment of people for whom payment is not quickly made follows the same pattern: They are locked in a basement, handcuffed and beaten, sometimes raped. A customer's finger may be crushed or cut off as he sobs into the telephone: Sell the house. Sell anything. Do anything. Make the payment or I'll be killed. Often there is disbelief at the other end of the line. If one has arrived safely in America, surely the hardest part is

To disappoint their families back home would be to lose face, a concern fundamental to Chinese culture. But many of these men have a special reason not to return home empty-handed. They have paid smugglers—whom the Chinese call snakeheads—about \$35,000 for their trip to the U.S. The smuggled men borrowed this money from family and friends and must pay it back. One of Chien-Chi's friends, who refuses to meet me, has just smuggled his wife in, raising their debt to about \$70,000.

Revenues from smuggling Chinese to America—most of them end up in New York City—now run as high as 600 million dollars a year. Many snakeheads engaged in this traffic are also involved in drugs, counterfeit credit cards, and food stamp fraud.

"We've successfully broken most of the old-style, family-oriented crime organizations traditionally associated with Chinatown," a

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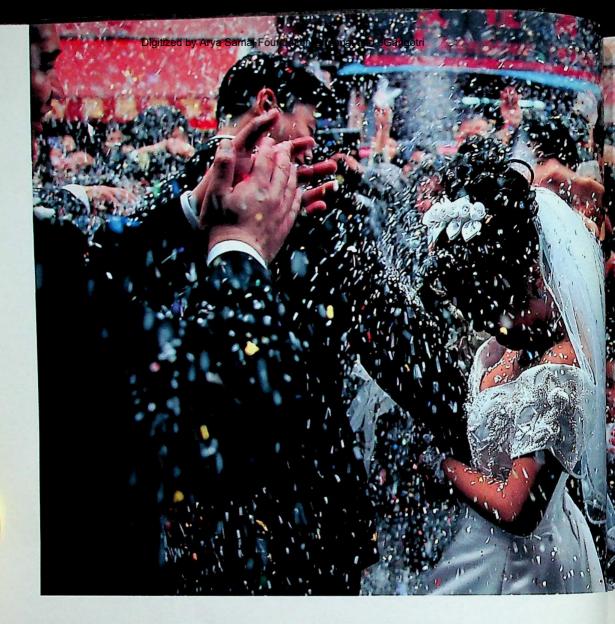
NEW YORK'S CHINATOWN



Fat, fresh, and ready to fry



Presented with two hogs, a Chinese chef might prepare shredded pork with garlic sauce or roast pork with broccoli. But don't call these dishes "Chinese food," because there is no such thing. There are only regional cuisines: Cantonese, Fujianese, Sichuan—or American.



over. An increasing number of customers are being forced into indentured servitude because financial resources in their home villages have become depleted.

Prosecution of snakeheads is difficult because they inspire so much fear and because many in the Chinese community have little sympathy for the victims, who agreed to pay the snakeheads' fee. Economics is also a factor. Peter Kwong, chairman of the Asian American Studies Program at Hunter College in New York City, has lived in or near Chinatown for 15 years. His new book, *Forbidden Workers*, argues that the traffic in, and abuse of, illegal immigrants is tolerated in part because the American economy welcomes cheap labor.

"It's a global economy," a federal official told me, explaining why he's not too surprised by conditions in Chinatown. "We can buy things made in sweatshops in China or in sweatshops here. It's all the same." Other officials insist that working conditions here, even in illegal sweat shops, are far better than in China.

look for steam from presses escaping through vents, and chances are it's sweatshop. Accompanied by Adelin Chung, my interpreter, I climb three flights of stairs and open a metal door. Inside are brid walls, clothes with designer labels piled on the wood floor, and sewing machines under long fluorescent lights. Clouds of thread particle hang in the air.

My grandfather worked in a sweatshop, but my grandmother refused to because fire killers of many workers. The danger persists. Despite a huge amount of flammable material and "N Smoking" signs (in English only), I can see the several workers are smoking. Boxes block the fire escape. Suddenly, a supervisor appears and the second supervisor appea

angrily orders us to leave.

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FAMILY TIES They wanted a small wedding but ended up with 800 guests and a 12-course banquet. "Out of respect for our families," explains Persephone Chan. "They say more guests means more happiness."

The man laughs. "They gave me \$50 a finger," he says. "Now I have no job."

visit Feng Jheng and Tian-Li Li. Six months have passed since their wedding. Now they live in the Bronx, where they own a restaurant. The neighborhood is working class, mostly black and Hispanic.

For breakfast on a Sunday morning, Feng suggests we meet at McDonald's—for them a welcome novelty. They tell me how a bank loan allowed them to purchase their new restaurant from a fellow Chinese.

Their days are long; the small, four-table restaurant is open every night until after eleven. I tell them how much their challenges resemble what my grandparents must have faced and read to them from a book my grandfather studied to learn about his new country: "You have come with . . . hopes and ambitions. . . . You have before you many disappointments."

"That's for sure," Tian-Li says.

"You have also before you," the book continues, "the possibility of the success of which you have dreamed. . . . In America we are all immigrants."

Later that day, as we drive from the Bronx into Chinatown so that Tian-Li can pick up supplies for his restaurant, he tells me of his dream. He and other immigrants plan to buy a farm to grow Chinese fruits—litchi and longan—in American soil, for sale in Chinatown. Tian-Li has already scouted for real estate in southern New Jersey. Two of his cousins, who work on a New Jersey farm, told him about the latest developments in farm machinery and plant genetics.

"I won't be doing this restaurant business for long," Tian-Li says. "In about a year and a half I'll have saved enough money to pay my share of the land and rent the machinery."

Everything about Tian-Li tells me that—yes—he'll have that farm. Saying good-bye, I tell him that the next time we meet, my children will be climbing his longan trees.

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Over the next week, through interpreters, I talk with dozens of garment workers. Many say they're satisfied. One woman claims she earns more than \$30,000 a year. "We don't tell the government," she says, "so we also get food stamps." But most describe a life my grandfather would have found familiar: pains in the back, legs, and arms; long hours growing longer. "What about the eight-hour workday?" I ask. "I'd be happy with ten or twelve," one woman replies.

Many, or perhaps most, garment workers also are paid far below the legally mandated minimum wage of \$5.15 an hour. Sometimes employers refuse to pay their workers on a regular basis.

On a street filled with garment shops two men sit on stools, talking. One is missing several fingers. "How did you lose them?" I ask.

"Cutting cloth."

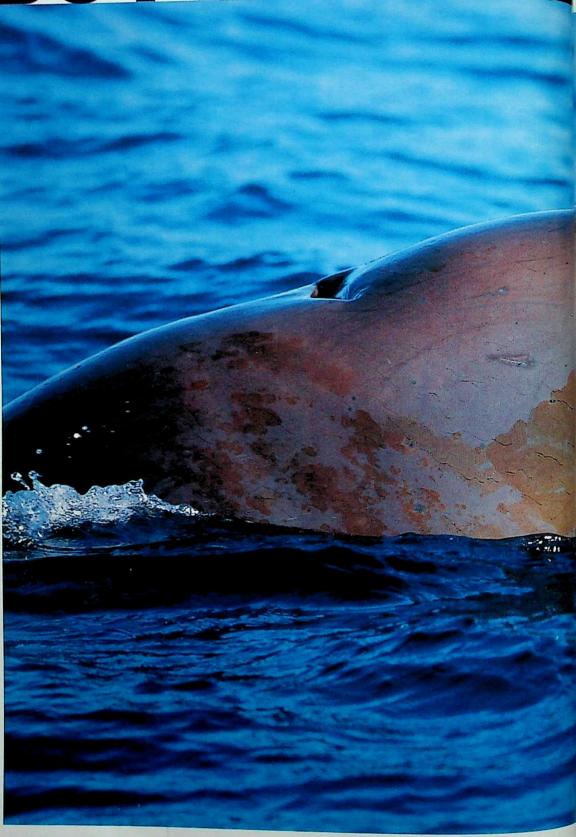
"Did you get workers' compensation?"

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BY DOUGLAS H. CHADWICK PHOTOGRAPHS BY FLIP NICKLIN

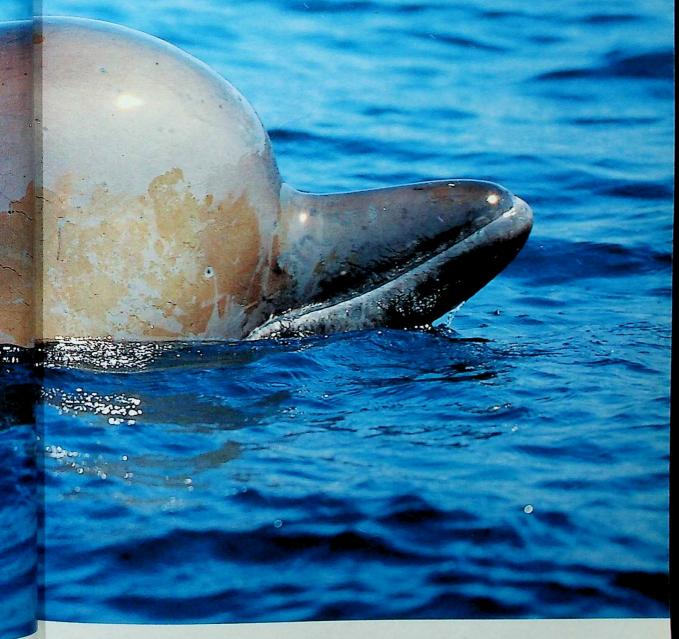
BOTTLENOS



The snouty profile of a northern bottlenose whale surfacing off Nova Scotia gives away its pedigreen Reakerd whaters are allowers at known large mammals on CKLIN

WHALES

Pioneering research tracks deep divers of the North Atlantic



Earth. Biologist Hal Whitehead and the crew of the research vessel *Balaena* are the first to study the behavior of these enigmatic creatures in depth.

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ит in the gray-green ocean 185 miles east of Halifax, Nova Scotia, fogs cloak the surface a third of the time, storms raise waves 50 feet high or more, and a thin crescent of dunes slowly wanders the edge of the continental shelf like a lost beach, forever building at one end and being eaten away by winds and currents on the other. This is Sable Island, whose shoals have claimed some 500 ships and 10,000 men over the years. Mariners came to call it the Graveyard of the Atlantic.

Fifty miles farther, the seafloor suddenly drops away into the biggest ravine off Canada's east coast. Seafarers named this place the Gully, but it is more like a drowned Grand Canyon, a dozen miles across and, in places, a mile straight down to the bottom.

Our sailboat ghosts over the Gully in a blur of mist. The only sounds are of rollers schussing past the hull and the creak of the rigging as it sways. Breaths like great, bursting sighs sound through the fog. Four creatures 20 to 30 feet long have risen from the chasm. The smallest one swims for the boat. A larger companion cuts it off, and they rejoin the others to float like swollen logs a short distance away.

DOUGLAS H. CHADWICK and FLIP NICKLIN, both frequent contributors, are collaborating on a series of articles about whales.



IVAR CHRISTENSEN

A loud sigh and misty spout announce an algae-coated 20-foot cow and her calf (facing page). Whalers may have preferred mature bulls, like this 30-footer taken by Norwegians in 1971 (left)—two years before the last commercial hunt.

They have small fins but big, domed heads that bulge above narrow, protruding iaws. I can tell, because their heads are two-thirds out of the water now, all pointing our way. These animals aren't just watching us. A hydrophone quickly flung over the starboard rail reveals that they are scanning us with trains of rapid clicks just above the range of human hearing. We are being studied by northern bottlenose whales. Which is only fair, since that's what we came to do to them.

The northern bottlenose and at least 19 closely related midsize whales form the family Ziphiidae. Referred to as beaked whales, they add up to one of every four species of cetaceans—the marine mammals known as whales, dolphins, and porpoises.

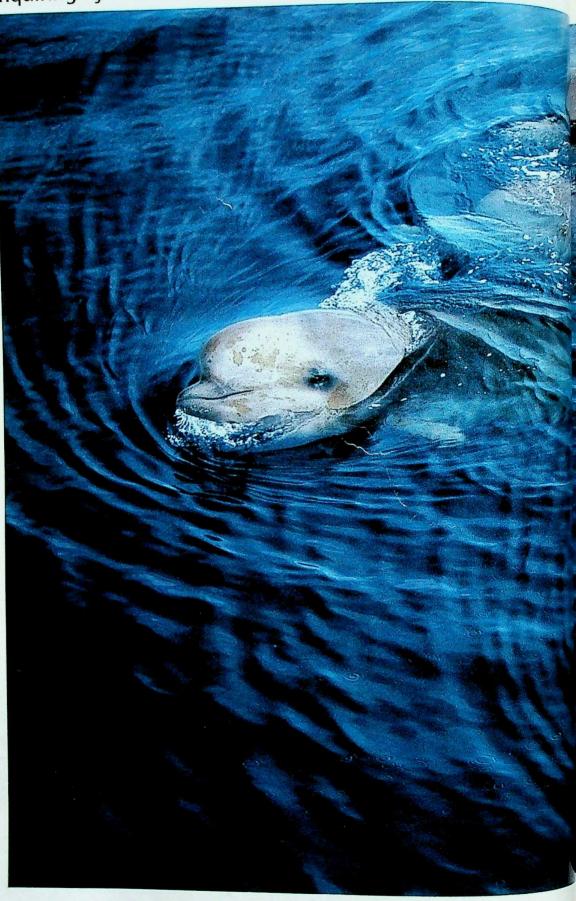
The public may be infatuated with whales, but most folks wouldn't recognize a Cuvier's, Sowerby's, ginkgotoothed, or any other kind of beaked whale if one surged through the living room. Even among scientists, ziphiids

probably qualify as the least familiar of all big mammals. Several have only been glimpsed. Others are known solely from the odd carcass washed ashore.

Varying from 11 to 42 feet in length, beaked whales are typically toothless except for one or two pairs on the lower jaws of males. Most live fairly far offshore over deep waters. Pitting warm blood against darkness, cold, and unimaginable pressures, they plumb those depths in search of squid and an assortment of fish. Beyond such basic facts, records of ziphiid lives are almost as blank as the white sails hoisted by the Balaena, the 40-foot boat whose crew I have joined.

"These are some of the most extreme animals on the entire planet, probably among the most intelligent, and we hardly know a thing about them," says the captain, Hal Whitehead, a whale expert from Dalhousie University in Halifax. "It's as though you found various species of apes that appear to be as complex

Inquiring eye



Who's studying whom? A calf returns the stare of *Balaena's* crew. Other whales rest on the surface as still as logs, breathing calmly before the CC-0. In Pdht bdiyan Bothlan Kangyi Ballestion Haridyst investigating *Balaena*. They



rew. Other efore the a. They often circle her, scanning with eyes and sonar clicks. Such curiosity can kill. When hunters entered bottlenose territory, they would cut their engines, wait for whales to approach, then fire their harpoon cannons. CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar

as gorillas and chimps but live deep in the forest and remain a mystery. Beaked whales are a whole new frontier."

Hal began sailing at the age of eight in England, his native country. He went on to earn a degree in mathematics before the sea drew him back to take up the study of whales. Surveying male sperm whales that feed along the Scotian shelf over summer, he regularly found high numbers toward the Gully's edge and grew intrigued by reports of bottlenoses near the center.

"The first time I went out looking specifically for bottlenoses, I came up empty," Hal recalls. "On the next trip I was fogbound, finding nothing, when the whales came to visit the boat. They stayed close a long time, rather like today, and I felt a special connection. That was ten years ago." Foul weather might hide the whales all but a couple of days during a three-week outing-as happened this trip—but the information has been building ever since.

Widely scattered clusters of the northern bottlenose whale, Hyperoodon ampullatus, are found from Nova Scotia eastward to the waters north of Norway. Animals have been sighted at the edge of the Arctic pack ice and even along leads several miles inside.

Already some ten feet long at birth, northern bottlenoses continue to grow in size until age 20, reaching up to 30 feet. Adults weigh between five and seven tons, roughly the same as African elephants. The oldest age recorded is 37. Sexual maturity begins as early as age seven. Pregnancy lasts 12 months. Mothers nurse their

young for a year and may reproduce every other year.

One more basic fact explains how we came by most of the others: Northern bottlenoses were the only beaked whales subject to intense commercial whaling. Scientists had lots of corpses to probe.

Intensive hunting by Norwegian whalers began in the 1880s as larger, more highly prized cetaceans were becoming harder to find. The inquisitive bottlenoses' tendency to approach boats, coupled with their reluctance to abandon an injured companion, made them a harpooner's dream.

By the late 1920s, some 60,000 northern bottlenoses had been rendered into vats of grease. As the population declined and cheap petroleum reduced the demand for animal oils, the slaughter slowed, but northern whaling nations would go on to kill thousands more for their meat, much of it sold to British pet-food companies. "I had no idea the dogs and cats of my childhood were eating these strange, endearing animals," Hal says.

The commercial harvest ended in 1973, when whalers sold exactly three animals. Although the original size of the population will never be known, authorities think 130,000 is the maximum. Whaling reduced it by at least 70 percent, and the species remains depleted today.

N AUGUST 10, after the Balaena puts into port for minor repairs and new supplies and then noses back toward the Gully, I sign on with a fresh crew for three weeks. The new skipper is Sascha Hooker, a doctoral candidate studying bottlenoses under Hal's guidance. Robin Baird shares the research responsibilities, and Brad Carter, a ponytailed young salt with many a sea mile in his wake, is first mate.

Three volunteers round out the list: Cheri Recchia, former marine-sanctuary specialist for World Wildlife Fund-Canada; Annie Gorgone, whale-watching guide; and myself, chief landlubber, a cringer when waves rise and winds make the rigging sing.

Shearwaters from South American breeding grounds glide so low in the rollers' troughs that their wing tips seem to merge with their reflections. The closer we get to the Gully, the livelier the encircling sea grows. I lean over the rails applauding the fellow mammals that have begun to escort us. Common, Atlantic white-sided, and striped dolphins slalom across our bow wave, swim upside down, go airborne, then roll onto one side to look up at me.

For elbowroom, I climb the mast to the crow's nest. Hanging on for dear life in my own private Tilt-A-Whirl, I súrvey 360 degrees of a world perfectly divided between water and sky. Before long I've learned to tell the tall, columnar spouts of blue whales from the low geysers of humpbacks. My first sperm whale floats among whitecaps, loosing a vapor stream from the blowhole skewed to one side of its colossal head.

At the fork of a major current, the Gully, with its swirls of nutrients, is habitat for a dozen kinds of cetaceans. The bottlenose turns out to be the most common one

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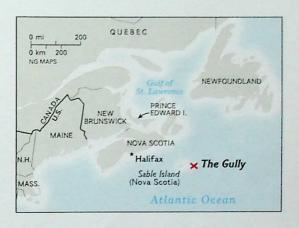
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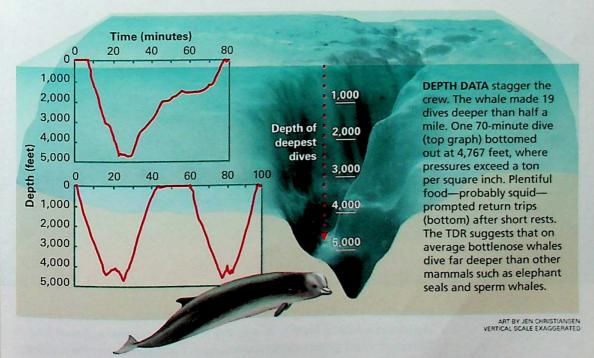
GUST 199



Hitching a deep ride

Bottlenose whales spend only 15 percent of the day at the surface. To learn what they do in deep water, the team uses a crossbow and a suction-cup dart (above) to attach a time-depth recorder (TDR), a palm-size device bundled with a float and a radio transmitter (above right). Finding targets is the easy part. Whales congregate over the deepest parts of the Gully (art below), a submarine canyon 235 miles off Halifax. Getting TDRs to stick is harder. After days of frustration a TDR was finally secured to a whale for 28 hours.





Synchronized swimmers



Symmetry in motion, two whales surface and exhale in unison, emerging to the rarest of North Atlantic days—a clear sky and a glassy sea.

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time, the team's research suggests that the social bonds of most bottlenose whales are as transient as a teenager's. A month from now these whales will be swimming in sync with new best friends. CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar

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above dolphin size. As a rule we'll first see their bushy spouts far from the boat. We hurry over the swells and arrive to find that the whales have submerged on a long dive, presumably in search of deepwater squid, their favorite fare.

Then the waiting begins. It is how I imagine things were in the whaling days: seemingly interminable stretches of silence and tense expectancy followed by a sudden frenzy.

"Blows! Sixty degrees port side, 200 yards off!"

The helm wheel spins. Lines zither in and out as sails are realigned. Bodies race to quarters bearing binoculars, cameras, data sheets for noting behavior, and our miniature harpoon gun—a crossbow. It fires an arrow with a hollow tip designed to collect a tissue sample

no larger than a pencil eraser.

Normally in groups of five or less, the whales have begun to join as many as a dozen others. The most noticeable additions are adult males with their imposing foreheads. They look like aquatic geniuses but are probably here out of lust, for late summer is the breeding and calving period. DNA from skin in the tissue plugs will help gauge the extent to which bottlenoses in the Gully, the species' southernmost population, are genetically isolated and therefore more vulnerable than those in contact with neighboring gene pools. Examining the chemistry of the blubber in a sample can provide clues about an animal's health and the type of food it favors.

To minimize disturbance, the samples are taken from only a small fraction of the whales and rarely from a group with a calf. But we photograph every bottlenose's head and dorsal fin when conditions allow. Markings on these areas are seldom the same for any two animals.

The Dalhousie team has identified scores of individuals. Graduate student Shannon Gowans later explains, "The more we are able to recognize, the sooner we can sort out social relationships." And the more closely researchers can estimate the size of the Gully population. The latest figure is 200 to 300. Most can usually be found within a five-by-twelve-mile area. This is a small piece of ocean to inhabit, but it is linked to very particular topography: the center of the chasm mouth, its deepest part.

If the bottlenoses don't swim too fast, we can keep

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Whale of an attention getter, the bottlenose sometimes slaps the water with its flukes, perhaps in response to interlopers. A signal for humans as well? "Possibly," says Whitehead, "but I don't know if we're getting the message."

up and observe them in close formation, their movements accompanied by grunts, whistles, and Bronx cheers made by the blowholes. Every so often, one repeatedly lifts its flukes to give the water a resounding slap. Termed lobtailing, the display may function as yet another way to be heard. The same holds for breaching, though there is always the possibility that whales leap skyward and make a huge splash just because they can.

The paramount question is what goes on the other 85 percent of the time, when these animals are not on the surface? Men walked off whaling boats with stories of harpooned bottlenoses that dived and reeled out 500 fathoms of line—3,000 feet—in less than two minutes. One took out 6,000 feet, supposedly straight down. Injured animals were said to stay under a full hour or even two.

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Such facts seemed exaggerated. Yet shortly before I joined the Balaena, Sascha and Robin tagged a bottlenose with a time-depth recorder (TDR), using the crossbow and a rubber suction cup to attach the device to the whale's skin. The TDR stayed on four and a half hours and surfaced with the first solid data ever obtained about a ziphiid in its submarine realm. Descending at a pace to match any whaler's tale, the bottlenose made several dives. One reached a depth of 2,800 feet,

where pressures exceed 1,250 pounds per square inch.

We have three TDRs ready on this trip. The circuits in the first frazzle. Number two develops battery problems. The third must be the least aerodynamic package invented since the bread loaf. Robin and Brad fire it at whale after whale, only to watch the thing pinwheel off into the drink.

LMOST TWO WEEKS pass without success. We all but give up. Sascha steers Brad close to a group of 11 bottlenoses. He tries one more shot, and we all run forward to see a young whale plunging away with the device stuck just below its dorsal fin. Now the challenge is to keep track of the TDR by its radio signal, which can only be traced at intervals when the whale surfaces. It ought to come off in eight or ten hours, issuing a steady series of blips for retrieval. But as night falls, we're hearing nothing at all.

During my watch in the wee hours, I get a faint signal. It fades after a few minutes. That means the TDR is still on the whale. Great. As long as it detaches soon. Another gale is forecast. Even if we stay and ride out the gusts with the sails reefed, big swells will carry off the TDR when it comes loose.

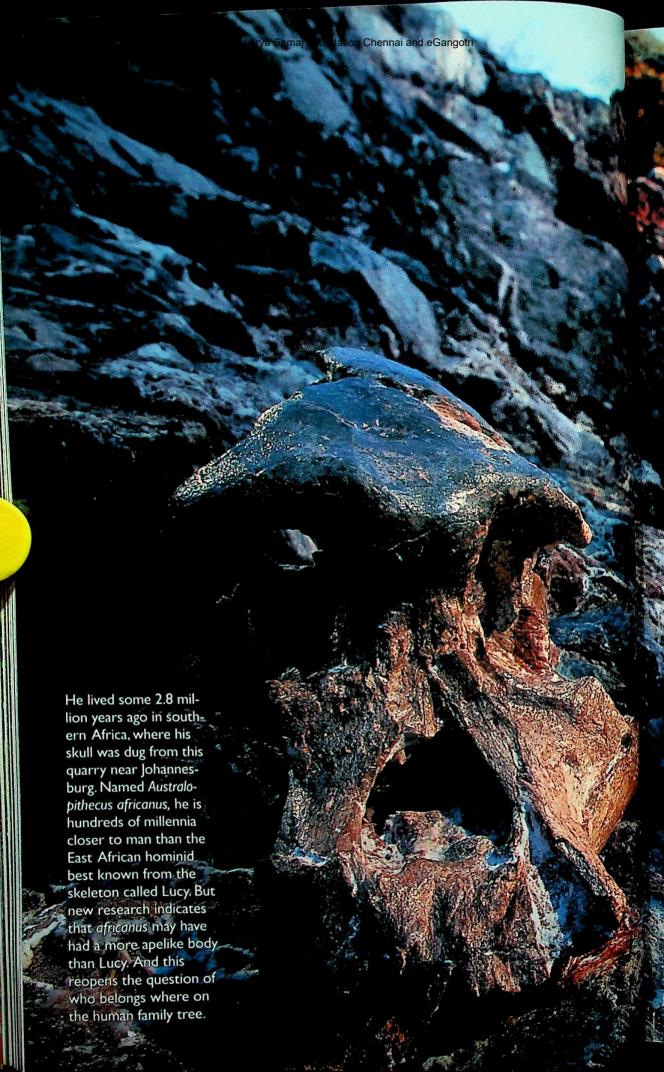
Morning dawns clear, and by midafternoon we have found more groups of bottlenoses than on any other day, but no clear radio signal.

The least frivolous person on the ship, Captain Sascha, suddenly bolts toward the bow with the radio receiver and earphones and a giddy grin, crying, "Beep! Beep! Beep! Beep!" Cheers erupt from all hands. The TDR has floated free after 28 hours. At dusk I scoop it up with a net, and we turn for Halifax to beat the storm. We will have journeyed 1,400 nautical miles this time out. The hand-size packet dripping onto my sleeve will more than triple what the researchers know about bottlenoses in the depths.

Not far from Sable Island we pass a massive well-drilling platform. Gas flares roar from flues on its superstructure, casting a dragon's breath glow on the sea a hundred feet below. A number of new platforms may soon reach along the Scotian shelf in the direction of the Gully to tap six natural gas fields. With more wells possible within prime bottlenose range, Canadians are debating a proposal to have the Gully declared a marine sanctuary.

After downloading the TDR's computer chip, Sascha tells me that the longest dive lasted an hour and 10 minutes and went almost a mile down. The whale made three other dives that plunged just as far. These revelations bolster Hal Whitehead's hunch that the world's deepest diver is the bottlenose whale—or one of the many other beaked whales yet to be studied.

BOTTLENOSE WHALES CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar



Digitized by Arya Samaj Foundation Chennai and eGangotri THE DAWN OF HUMANS Redrawing Our Family Tree?

By LEE BERGER Photographs by KENNETH GARRETT Art by JOHN GURCHE

o you're saying they've got long arms and short legs, more like an ape?" asked Henry McHenry as he looked at the sketches and casts of 2.8-million-year-old hominid bones lying scattered on the floor of a hotel lobby in Oakland, California. "I think so," I said tentatively.

Not even a year into my Ph.D., I was trying to convince one of the world's leading paleoanthropologists that his previous interpretations of our distant kin *Australopithecus africanus* (southern ape of Africa) were wrong.

I had come to California from South Africa, where for five years I had been living and studying new hominid fossils from a limestone quarry called Sterkfontein. Most of these fossils had been recovered by my mentor, Phillip Tobias, and his team, but they weren't widely known because of South Africa's isolation during its apartheid years. While I was writing my dissertation on australopithecine shoulder bones, I wanted to describe limb size in relation to the rest of the body. As I did my calculations, I noticed something very odd: The pattern didn't fit with current notions of what africanus ought to look like.

I NOTICED SOMETHING VERY ODD: THE PATTERN DIDN'T FIT WITH CURRENT NOTION

Beginning about four million years ago, australopithecines roamed much of Africa. Those small-brained hominids—the transitional species between apes and humans—walked upright on two legs, the first hallmark of the human family. Scientists have identified at least seven species, but most assume that *Australopithecus afarensis*, which inhabited East Africa, begat a succession that led to our genus, *Homo*, about 2.5 million years ago.

Henry and I were conducting our minidebate during a break in a professional meeting held in 1995. If I was right, then we paleoanthropologists would have to change our thinking about *africanus*. These southern hominids, which some scientists thought were a side branch on the human family tree, might be much closer to the main trunk—or perhaps even the species that became *Homo habilis*, the first member of our genus.

But in 1995 this theory was close to heresy.

LEE BERGER is a professor of paleoanthropology at the University of the Witwatersrand in South Africa. Photographer Kenneth Garrett is a veteran of 21 Geographic assignments, including six earlier stories in the "Dawn of Humans" series. Artist John Gurche draws on his training in anthropology as well as his artistic gift to flesh out bare bones.

As was well known, the early East African hominids had a primitive head and a surprisingly humanlike body, but I found that their southern counterparts looked much more like apes from the neck down. I was puzzled, because from the neck up they were more humanlike than their older East African cousins.

But I needed better data, and Henry had it. Over the past two decades, at the University of California at Davis, he had tabulated the body weight and bone lengths of hundreds of humans and apes, assembling a database that enabled him to estimate the weight of an individual based on a single bone or joint. He could also calculate the length of almost any bone from just a tiny fragment of a joint. Without these data I couldn't prove my case, sol was eager for Henry to see in these bones what I had seen.

Henry picked up the casts of an africant pelvis and sacrum—the bone where the spint connects with the pelvis—and compared then with two arm bones from the same animal "They do look out of proportion," he said "The lower body parts are too small for the upper body parts."

Intrigued, Henry embarked on a three-year

When author Lee Berger examined this partial africanus skeleton, he noticed that its limb proportions were less humanlike than those of Lucy. Alone, this might make africanus a less likely human ancestor—but the first *Homo* species may also have had relatively long arms and short legs.

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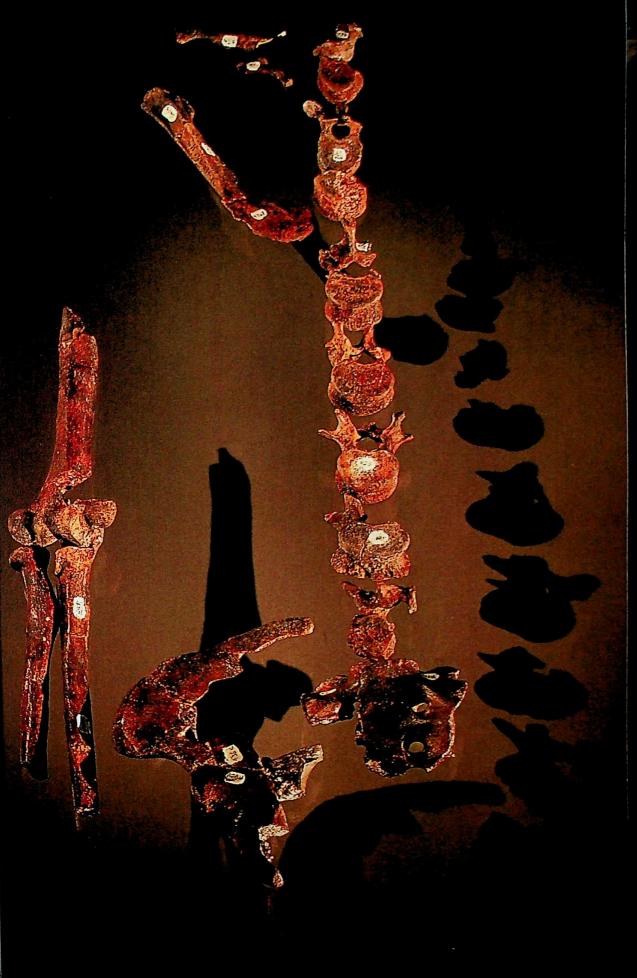
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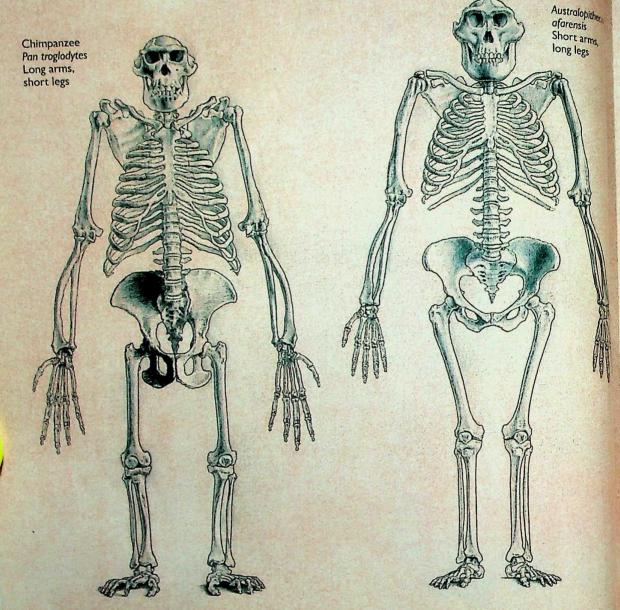
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UST 199



Old bones tell a new story



Because the fossil record for early hominids is so fragmentary, inferences and predictions fill in the gaps. In the absence of fossil specimens complete enough to gauge africanus's body dimensions, it had been assumed that the species had at least as humanlike a build as

the earlier afarensis, Lucy's species. Well-preserved skulls show that africanus had a slightly larger brain than afarensis, as well as skull features that resembled those of the first Homo species.

But a closer look at the available fossils reveals that

africanus may have had longer arms and shorter legs—limbs that were more chimplike—than afarensis. If so, the implications are striking. One possibility is that hominids underwent an evolutionary reversal between afarensis and africanus, perhaps to adapt to a more arboreal

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Homo habilis

Ancestral hominid

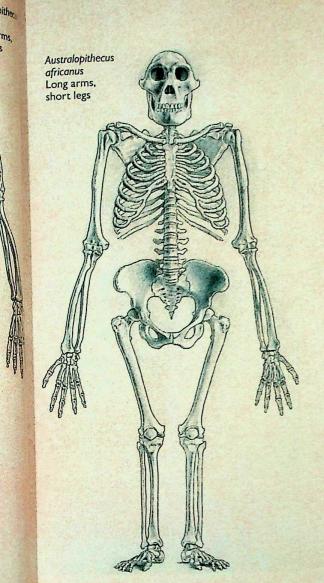
Australopithecus africanus

Berger's proposal

Conventional views

CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar

Australopithecus afarensis



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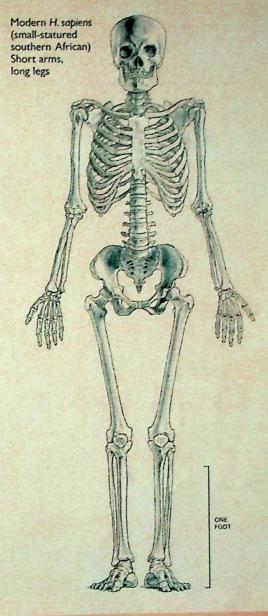
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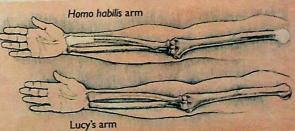


environment. Berger thinks it more likely, however, that the two species evolved separately. "The most probable idea is that afarensis and africanus are sister species that share a missing-link ancestor." If so, only one could have been ancestral to humans.

Present

Later Homo species including H. sapiens

Homo erectus





THE LONG AND SHORT OF IT If the first Homo species, Homo habilis, descended via Lucy, one would expect its arms to be shortened and thus more humanlike. But a reconstruction using limb fragments (fossils are shaded here) suggests the opposite. The thighbones are the same length, but habilis's arm is longer, making it more akin to africanus's than to Lucy's. But too few habilis fossils have been found to draw firm conclusions.

project with me to study the Sterkfontein fossils. Our findings challenge the assumption that almost all the important events in human evolution occurred in East Africa—the so-called East Side Story.* The fossils from East Africa have told us one side of this complex saga; the remarkable new finds from South Africa are revealing another.

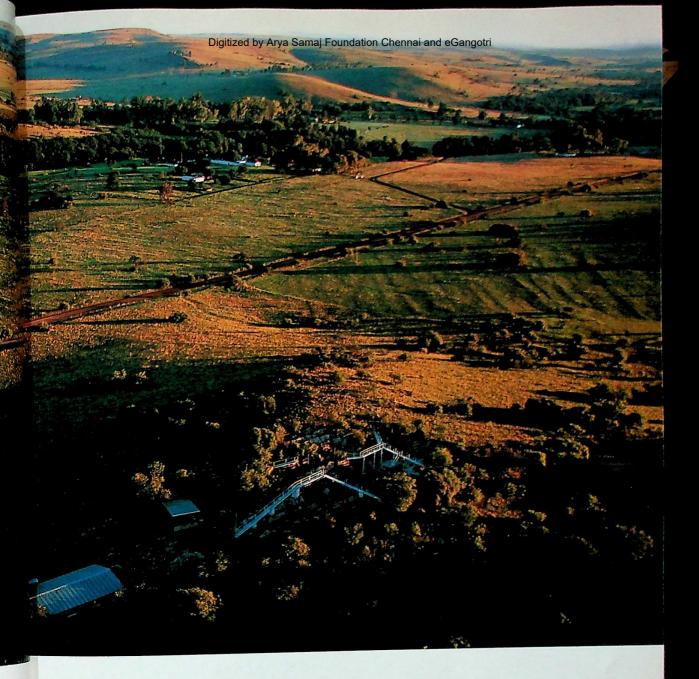
a paleoanthropologist, most people picture a lonely figure dressed like Indiana Jones scouring the crumbled ravines and weathered ridgetops of Africa's Great Rift Valley. Although I spend three or four months a year searching for telltale bones, I do most of my work in a fluorescent-lit laboratory at the University of the Witwatersrand in Johannesburg.

For me, finding the fossils is the easy part, even if the odds are only one in ten million. The hard work begins when those elusive bone fragments—some no bigger than a fingernail—arrive in the lab. As much as I love being in the bush, the rewards of this meticulous study are every bit as exciting and important as discovering a new hominid fossil.

*See "The First Steps," by Rick Gore, National Geographic, February 1997.



Though East African of orensis fossils have garnered more attention in recent decades, paleontologists have been digging africanus fossils from South Africa's Sterkfontein quarry since 1936. The most pro lific of four africanus sites Sterkfontein is nestled in a hill overlooking the Bloubank valley (above) which was probably a subtropical woodland be fore the area began drying 2.5 million years ago



The first australopithecine fossil made international headlines in 1925, after anatomist Raymond Dart identified an *africanus* skull unearthed in South Africa. Excavations there tapered off in the 1950s as the spotlight swung to East Africa with the pioneering work of Louis and Mary Leakey and the later discoveries of Richard and Meave Leakey, Tim White, Donald Johanson, and others. Now my studies and those of other colleagues are drawing the spotlight back to the unsung hominids of southern Africa.

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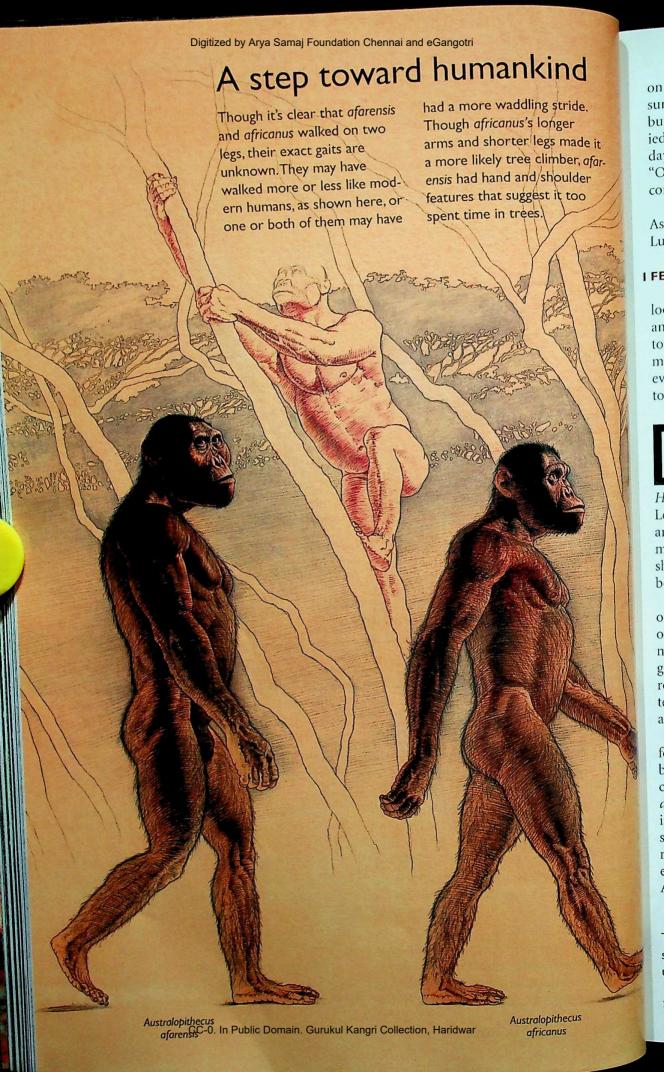
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In the past, based on work in East Africa, many scientists placed *Australopithecus afarensis* at the base of the family tree and drew a line leading ultimately to our own genus, *Homo*.

Lucy, the best known *afarensis*, roamed the savannas and woodlands of the Great Rift Valley between 3.9 and 3 million years ago. When I first came to South Africa, I accepted the hypothesis that Lucy and her kind were the ancestors of all later hominids—until I studied the Sterkfontein fossils.

To prove my theory, Henry McHenry and I compared more than a hundred fossil bones from Sterkfontein and Hadar, the Ethiopian site where Lucy was found. We also included two partial skeletons: Lucy herself and STW 431, a male *africanus* from Sterkfontein.

On Henry's first visit to my lab we emptied the safe of all the limb bones—about 20 percent of Africa's hominid specimens. We laid them



on a large, green-felt-covered table and measured each one. Henry had run the numbers, but he wouldn't believe the data until he studied the actual bones. After three exhausting days I felt relieved when Henry finally said, "OK." I knew if I could convince him, I could convince anyone.

Our analysis yielded some startling results. As might be expected, the *africanus* specimens, Lucy's supposed descendants, had heads that that the ability to walk on two legs like a human evolved only once. That bipedalism happened once means it might have happened many times. It may have arisen as a means of traveling between feeding patches.

I think bipedalism arose at least twice. Afarensis emerged in East Africa as a human-like biped but eventually died out. A second species—africanus—emerged at almost the same time in southern Africa, which may have

I FELT RELIEVED.... I KNEW IF I COULD CONVINCE HIM, I COULD CONVINCE ANYONE.

looked even more human, but their long arms and short legs were more primitive. They were top-heavy, as if the upper limbs belonged to a male and the lower to a female. For Lucy to evolve into these forms, evolution would have to go backward—which rarely happens.

had an apelike body mean we're kicking it out of the family tree? Quite the contrary. Discoveries of Homo habilis skeletons in Kenya by Richard Leakey's team and in Tanzania by Tim White and Donald Johanson indicate that the first members of our genus also had long arms and short legs. Perhaps they inherited their odd bodies from africanus.

So rather than being the legendary mother of us all, Lucy may be just another branch on

our family tree. And that branch might be a dead end: Lucy may have given rise to *Australopithecus boisei*, a robust australopithecine with big teeth and strong jaws that died out about a million years ago.

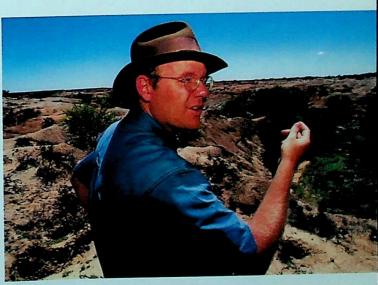
In fact, africanus shares more features with Homo habilis—a larger brain, shorter face, and smaller canine teeth, for example—than afarensis does. "I think africanus is close to the ancestor of Homo," says Henry McHenry. That reinforces my own conviction that Homo emerged from africanus in southern Africa and migrated north.

Our data also challenge the idea

stayed forested longer, requiring it to retain the ability to climb trees well. A complex mix of habitats with diverse predators and food sources may have stimulated *africanus* to become smarter—and its brain gradually to grow nearly as large as that of *Homo habilis*.

As more fossils turn up and scientific methods improve, new information will shed light on these questions. Did africanus evolve from afarensis and revert to a primitive apelike body? Or were afarensis and africanus sister species? If there was a common ancestor, what did it look like? Did it have an africanus body and an afarensis head? Whatever the results, one fact is clear: The paths of human evolution are far more complex than ever imagined.

Lee Berger has published his findings in the Journal of Human Evolution. For a link, go to www.national geographic.com/media/ngm/9808/berger/.



The fossil record has grown exponentially since Charles Darwin called it "paltry," but scientists are still trying to assemble broad theories from small piles of bones. Berger (above) thinks South Africa's unexplored terrain can help fill some gaps. "We're digging a lot of new sites that have fantastic fossils."

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PLAGUE OF FIRM

BDUR RANI hunkered on the ground behind his home, little more than a box he'd nailed together from raw timber, and gazed across the still smoldering terrain at the acreage he'd just burned bare. For miles around this scorched field in southern Kalimantan, the Indonesian portion of the island of Borneo, the rolling land was baked black and crisp, dusted with feathery white ash. Tendrils of smoke curled from the peat ground cover and floated into the chrome yellow sky. Here and there charred and shattered tree trunks punctured the horizon, remnants of what had once been a dense tropical rain forest. The stillness of the sweltering afternoon was broken only by the rumbling and geargrowling of trucks hauling hardwood logs to the nearby Java Sea coast over roads that slashed the wilderness like red scars. In this landscape I could see only death and destruction. Abdur Rani saw opportunity, a new cycle, life itself.

To Abdur, a Dayak tribesman and a slash-and-burn farmer, fire is a regular marker on life's clock. He

By LEWIS M. SIMONS Photographs by MICHAEL YAMASHITA

Ingredients for an environmental nightmare: late monsoon rains; the use of fire to clear land, practiced here by a farmer in Kalimantan; and industrial-scale deforestation. The resulting smoke from fires in Indonesia poisoned Asian skies.







Digitized by Arya Samaj Foundation Chennai and eGangotri

counted his age, 41, by the annual rice-preparation fires he, and his parents before him, had set since his birth. Unlike subsistence farmers elsewhere who ready the soil by plowing and keep it productive by fertilizing, Abdur and millions like him burn off a few acres, plant, and then, in a few years, move to a nearby patch, repeating the process over and over again.

Slash-and-burn agriculture has been practiced for centuries throughout the tropics. By itself, it has done relatively little to destabilize the balance of nature in the rain forests, little more than, say, forest fires triggered by lightning in the northwestern United States. Small farmers generally control the scope of their fires carefully. But the Indonesian fire equation has changed dramatically in the past decade with the worldwide boom in tropical products such as palm oil.

The result, as seen in the 1997 round of fires, is one of the world's great environmental disasters. The land burned in Indonesia during that dry season has so far been estimated at 8,000 square miles, roughly the size of New Jersey. (This assessment will almost certainly grow; after the last great Indonesian drought,

Lew Simons, a Pulitzer Prizewinning reporter who began his career covering the Vietnam War, says that the fire damage in parts of Indonesia looked as bad as anything he'd seen caused by U.S. carpet bombing in Vietnam. The photography of freelance MIKE YAMASHITA, a frequent contributor to the magazine, has been displayed at the National Gallery of Art.



in 1982-83, it took experts three years to determine that 12,000 square miles had been torched.)

An estimated 20 million people were treated in the 1997 fires for illnesses such as asthma, bronchitis, emphysema, and eye, skin, and cardiovascular diseases: a passenger plane crashed in poor visibility over Sumatra, killing 234; ships collided in the Strait of Malacca, killing dozens. Pollution cost regional economies billions in aborted tourist plans, canceled airline flights, lost workdays, medical bills, and ruined crops. Wildlife has

suffered too. Every day orangutans fleeing the smoke ambled, disoriented, into a conservation reserve near Pangkalanbuun; they were weakened by infections and respiratory ailments.

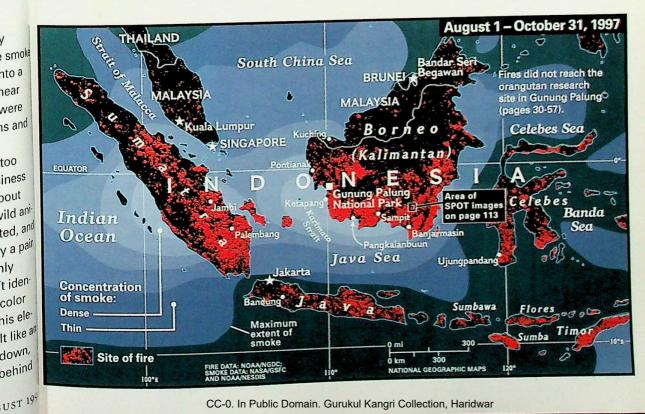
Abdur Rani was far too occupied with the business of survival to worry about the effects of fire on wild ani mals. Bald, bare-chested, and barefoot, he wore only a pair of shorts, so thoroughly patched that I couldn't iden tify what the original color had been. He was in his element. I looked and felt like an alien. From the eyes down, my face was hidden behind



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EXPORTING SMOG

The lofty lights of Kuala Lumpur, the capital of Malaysia, dim under a cloud of smoke blown in from the forests of Borneo and Sumatra, the site of most of Indonesia's unchecked fires. Desperate officials ordered that all high-rise buildings have water sprayed from their heights to dissipate the choking haze. At its worst, before rains came in November and doused the fires, the pall spread over eight countries and 75 million people, covering an area larger than Europe.



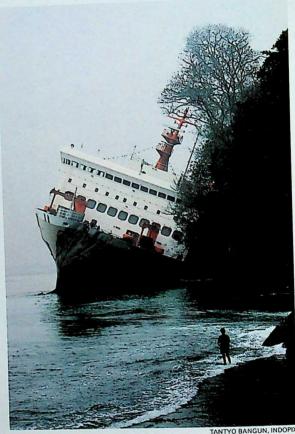
NO WAY OUT

A ferry lies useless off the smogbound coast of Sumatra after smashing into a rock. Elsewhere a jetliner crashed, ships collided at sea, cars ran off roads. A shipment of surgical masks reached Jambi, Sumatra (right), but such masks provide little protection against particle-laden haze.

a blue-rubber respirator sprouting twin disks covered in pink fuzz. Inside the mask, my face ran with perspiration, while the rest of me was slathered in a reddish paste of road dust, soot, and sweat. I was a walking amalgam of a chimney sweep and R2-D2.

What passed for air seemed more like oatmeal, thick with carbon monoxide, sulfur dioxide, and other poisonous substances. I had no idea what the air pollution index, or API (coincidence: api is Indonesian for "fire"), was around Abdur's field outside the town of Pangkalanbuun. But I had already been in places where the official count was reported above 800, which doctors said was the equivalent of smoking four packs of cigarettes a day. By international standards an API of 100-200 is "unhealthy," 201-300 is "very unhealthy," 301-400 is "hazardous," 401-500 is "very hazardous," and anything higher is "dangerous." What we were inhaling, I guessed by the limited visibility and the tart taste on my tongue, must have been around seven or eight packs.

Abdur drew deeply on a vellowish kretek, the Indonesian cigarette blended of tobacco and cloves. The kretek gives off a spicy scent and a sweet taste that I've always associated with the romantic East I discovered as a fledgling foreign correspondent.



But it's rough on the lungs. Unlike me, Abdur didn't seem to be giving any thought to his lungs.

"Fire is good," he explained patiently during the course of a long and convoluted conversation through an interpreter. "Burning the land means we'll have enough food to fill our bellies for the year. Fire is life."

Fire is also free. Clearing land by bulldozer costs about \$80 an acre—impossible for subsistence farmers. They operate in the wake of logging teams, mainly poachers, who scythe the forest, felling huge trees and skidding out

the trunks on bamboo tracks. Using the scrap timber left behind, the farmers build shacks for their families. Then, swinging heavy-bladed parangs, they slash the remaining brush and saplings, mound them high, and set the heaps afire.

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This time, taking advantage of a prolonged drought, Abdur had burned off much more than usual—the equivalent of five football fields. Even as some patches still smoked, he was planting bright green cassava seedlings alongside his house, In a few days, he, his wife, and their three children would jab



shallow holes into the warm peat with sharpened sticks and drop in rice seed.

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The 1997 drought, Indonesia's most severe in 50 years, was largely the result of El Niño. This periodic warming of Pacific waters reverses global weather patterns, substituting dry seasons for rainy, storms for calm, hot for cold. It had held back the monsoon, which normally begins in September, until November. Abdur had never heard of El Niño, but he knew that the late monsoon gave him better conditions to burn. "More fire means more clear land," he

said with a wave of his softly crackling kretek. "And more clear land means more planting and more food."

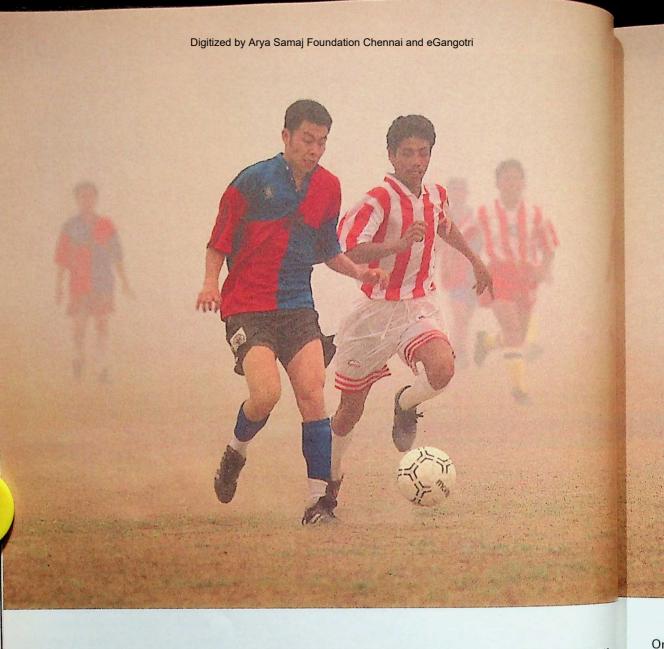
And more palm oil. Slash and burn has been industrialized. Giant agribusiness firms clear-cut the hardwoods for sale abroad, peel lesser trees into sheets for plywood, burn the scrub, and put in huge plantations of fast-growing, cash-earning oil palms for the world's soaps, salad dressings, and cookies.

Laying the bulk of the blame on those like Abdur Rani who burn to survive—which official propaganda and much of the resultant

news coverage did—muddies the reality. Only burning by agribusinesses could spread such a pall of air pollution throughout Southeast Asia and shrink Indonesia's rain forest so quickly. And if the fires burst out of control, either by accident or by design, and they frequently do, then plantations may be expanded that much faster.

or a month Mike Yamashita and I tracked the burning, experiencing its baleful effects. Then, shortly after I returned home, I began feeling as though my head were stuffed with cotton

INDONESIA'S PLAGUE OF FIRE



batting. I became dizzy and even fell down the stairs. I couldn't concentrate. One doctor guessed that pollution had affected the inner ear, disturbing my balance. I recalled that a farmer I'd spoken with had complained of similar problems. After two months my symptoms cleared up.

Accompanied by a pair of local guides and a succession of truck drivers and boat and ferry pilots, we traveled some 1,200 miles in Kalimantan through smoke and fire. We also visited the Malaysian capital, Kuala Lumpur, one of Southeast Asia's most

glittering cities. Even in normal times this low-lying city contends with industrial and automotive pollution. But Kuala Lumpur was in the flight path of the smoke coming across the South China Sea from Indonesia, and its residents were choking beneath a smelly, yellowgray shroud.

As we drove through the jungle of Indonesian Borneo, rarely were we out of blackened terrain. Often we were ringed by open flames and smoldering peat, which pumped out particularly noxious smoke. Mike, ever mindful of light levels, pointed out

that even though we were astride the Equator, the sun never pierced the smog sufficiently to cast a shadow. When the sun was at all visible, it seemed as small and pale as a brassy sequin past ed to a sheet of gray cardboard. Early mornings, midday, and late afternoons were indistinguishable—jus gray. Visibility was so limite that we were continually sta tled by motorcycle and bicycle riders, cars, trucks, and pedestrians suddenly popping out of the gloom. Only a few wore flimsy cloth of paper masks, largely ineffet tive against the poisonous®

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RECKLESS PLAY

With local health clinics overflowing with patients complaining of breathing difficulties, two weekend soccer teams play as if nothing is amiss in haze-shrouded Palembang. Some 48 million Indonesians were stricken by the smoke.

to school. The hardware man reported that he'd sold two masks.

We drove for hundreds of miles at a stretch, past rows of spiky green oil palms, some as tall as two-story buildings. At first the plantations seemed attractive, the trees heavy with clusters of the purple egg-size fruit that is the source of the rich oil. But as we traveled on, it became evident that entire forests had been destroyed to make way for these industrial gardens and that thousands more acres were going up in flames daily.

Indonesia ranks behind only Brazil in its endowment of tropical rain forest-10 percent of all that remains in the world. But the pace of burning is far ahead of planting, leaving a carbonized desert. Without ground cover to slow erosion, past rains had scrubbed the unpaved roads into ruts and canyons. Every few spine-crunching miles we had to pile out of our Indonesian-made utility vehicle, a Kijang, and shove timber scraps under the wheels for traction.

From time to time we passed collections of shacks coated in red dust—settlements of migrants from the teeming island of Java to the south. They're encouraged to move in exchange for five acres of land—part of which the government burns out of the forest for them.

Arriving at one of these settlements one afternoon, we met a dozen men unloading potted oil palm seedlings from a truck. A sign identified the plantation owner as the Good Hope company. The foreman, a genial migrant named Halim (like many Javanese he has only one name), said Good Hope was an Indonesian-Malaysian joint venture. This estate now measured about 50 miles by 50 miles, and crews like his were burning an additional 15 square miles a night to link up the property with another Good Hope holding 25 miles away.

Much like the slash-andburn farmers, those who work on the oil palm estates ignore the health hazards and environmental damage their work causes. For them it's a powerful economic incentive, a step up from what they knew before. "It's hard work, very hot and dirty," Halim said, "but we have our own house, and a garden for vegetables and even some chickens."

ment issued more forest-clearing concessions in 1997 than ever before, mainly to companies owned by wealthy entrepreneurs with connections to then President Suharto.

"The people who own these conglomerates have direct access to the president and

One evening in the market town of Ketapang, a clerk at the Taruna hardware store was hanging a dozen paper masks on a wooden rack. This was the only shipment received in four months, and he doubted he'd sell many.

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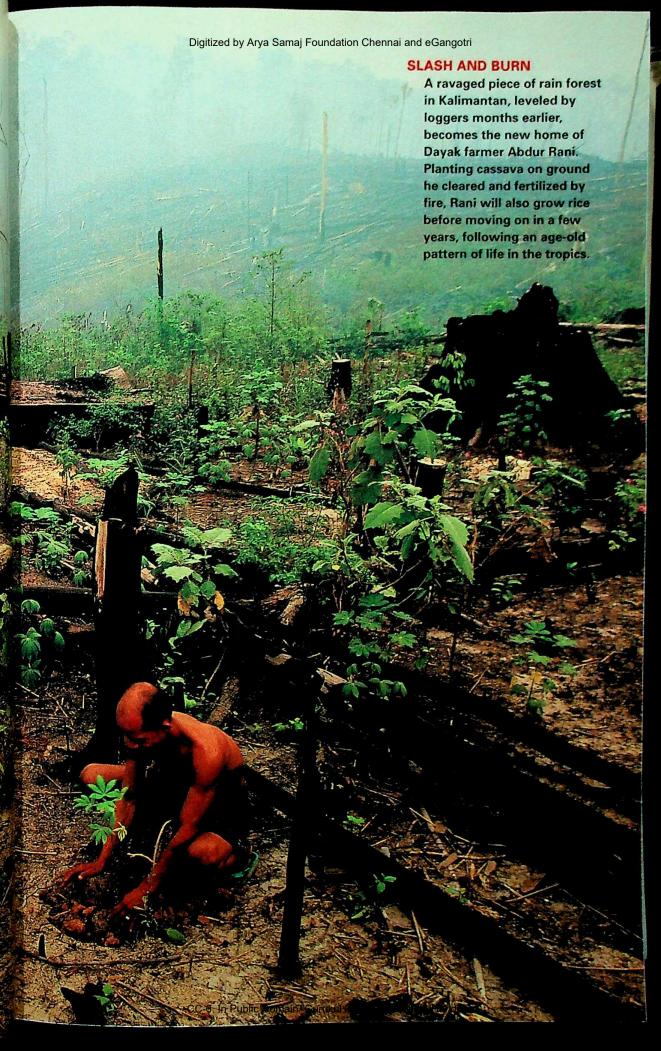
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"We haven't been told about the haze being harmful," he said. "I don't think it's dangerous."

The next morning I couldn't see more than 20 yards up Jalan Merdeka, the main street. Children in blue-and-white uniforms held rags to their noses as they jounced along behind their parents, who were scootering them





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his family," said Emmy
Hafild, director of the Indonesian Forum for the Environment. "There are a few honest ministers and senior bureaucrats, but the big businessmen are far more powerful than they are. Corruption is the standard in our country. There is no rule of law."

From the perspective of environmentalists like Hafild. the chief culprit is Mohamad Hasan, one of the largest forest concession holders. He acknowledges having two million acres, but his critics claim that's a fraction of the land he controls. Known to everyone as Bob, Hasan, an ethnic Chinese who converted to Islam in his youth, became Suharto's weekly golfing partner. Operating as spinmeister for Suharto in the fire crisis, he deflected my request to arrange an interview with the president. But he received me at his home in south Jakarta, a palatial cream-colored structure with a living room the size of a basketball court, ringed by concrete walls guarded by uniformed armed men.

A diminutive, mustached figure in an egg-yolk-yellow batik shirt, characteristically sockless in black slip-ons, Hasan nimbly launched into an impressive-sounding recitation of the laws limiting exploitation of the rain forest: "We have in our country 143 million hectares [353 million acres] of forest, of which 64 million are production forest-meaning we're limited to taking only five to ten trees of 50-centimeter diameter per hectare. Then, 30 million hectares are protected, meaning we can't touch

it, and then there's 19 million hectares of national park, which we also cannot touch. This leaves 30 million hectares of conversion land, which may be converted to agricultural purposes. Thirty million hectares out of 143 million is a small fraction." (It represents 21 percent of the area of the country under forest.)

Furthermore, Hasan said, industries based on forest products provide four million jobs. His land ("actually the people's land, which we're permitted to manage for them") is patrolled on the ground and by satellite. "I'd sack anyone who'd burn it." Indeed, he said, "I've suggested that the government take to court people who burn forest land. Because of my friendship with the president, Indonesia has become one of the world's leaders in reforestation."

The government claims that 1.5 million acres of forest were planted in 1996, but critics doubt this and allege that much more could have been done. An Indonesian economist said that in 1996 the 660-million-dollar national reforestation fund "loaned" 178 million dollars to a controversial national jet aircraft development program headed by B.J. Habibie, another Suharto friend. And 108 million dollars of reforestation money went to the giant Kiani Kertas paper and pulp project in Kalimantanowned by Bob Hasan.

Anyway, said Hasan, Indonesians weren't the ones setting the big plantation fires. It was being done by "outsiders," a euphemism for

Malaysians. Investors from neighboring Malaysia are joint-venture partners in newer oil palm plantations. Many are interested only in burning fast and far. But although Indonesia and Malaysia have never been wholly at ease with each other, for the sake of regional harmony their leaders dance an elaborate minuet in which neither points fingers.

Darkness." As we proceeded south from Kuching, in the Malaysian state of Sarawak



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SPOT IMAGES (BELOW) @ CENTRE NATIONAL D' ÉTUDES SPATIALES, TOULOUSE, FRANCE; PROCESSED BY CRISP, NATIONAL UNIVERSITY OF SINGAPORE

July 29, 1997

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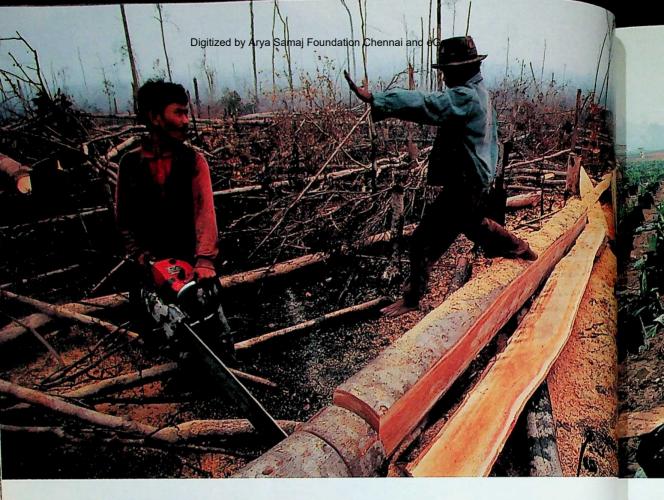
August 28, 1997



SMOKE SCREEN OF BLAME

As an estimated 8,000 square miles of land burned—an area as large as New Jersey—Indonesian officials looked for scapegoats. They pointed to an El Niño-induced drought that left ground so dry normal fires raced out of control, as in a banana plot (top) in Sumatra. They accused slash-and-burn farmers of clearing excessive amounts of land. But satellite imagery revealed the worst culprits. Large, influential companies were torching vast parcels of forest to create plantations for pulpwood, oil palms, and rice. Along the Barito River in Kalimantan (images above) so much land was burning that haze eventually blinded the satellite.

INDONESIA'S PLAGUE OF FIRE



PLANTATION MENTALITY

When clear-cutting stops, debris burning begins, as loggers in Kalimantan finish off remnants of rain forest to make way for an acacia tree plantation and its quick payoff in pulpwood. The government outlawed large-scale burning in 1995, but developers openly defy the ban.

down West Kalimantan, then east across the bottom of the island to the gem center of Banjarmasin, not just the air but the very quality of life deteriorated. At Pontianak, a gritty frontier-style city, residents waded side by side in the Kapuas River, the longest in Borneo, using its greenbrown water as a toilet and for bathing, laundering, cooking, cleaning teeth, and drinking. It was a sign of how far most of the 200 million Indonesians lag behind people in the more prosperous countries of the Association of South East Asian Nations, notably Malaysia, Singapore, and Brunei.

As the residents went

about their ablutions, a tugboat shoved a raft of cut logs, measuring perhaps 100 by 150 feet, downriver. Headed in the opposite direction, three tugs pushed and pulled a barge of gasoline against the current: out with the rain forest, in with progress.

We left Pontianak for the next substantial town to the south, Ketapang, aboard the M.V. Mitra Express II, a slightly seedy coastal cruiser imaginatively designed to resemble an airliner. As we shoved off, people on the dock were doing group calisthenics, vigorously sucking smog deep into their lungs. Three hours later, about halfway to Ketapang,

in the Karimata Strait, visibility dropped to zero. Then the boat stopped. It seems the navigator couldn't spot landmarks. We'd gone off course and run aground on a sandbar. Later, a few rickel fishing boats appeared, and the passengers, men first, clambered aboard the smaller boats for the remaining hour or so of the trip.

In Ketapang, Sarifah Hajijah, who assured me that
she was a pious woman and
had made the hajj, served
us a dinner of spicy venison
curry and rice in her threetable food shop. She apologized for the absence of
vegetables, because there
had been no sun for months

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Rows of oil palms start off fast in a 30,000-acre tree farm wrested from Sumatran jungle. But drought and haze-reduced levels of sunlight caused crops and trees to wilt, resulting this year in widespread food shortages and a suspension of palm oil exports.

"This is a curse from God," Sarifah asserted. "He's angry with us." Her daily income had dropped from ten to five dollars. "My grandson, he's two, is sick all the time. He coughs and he's dizzy. I did hear that we should wear masks, but there are none. Our government doesn't care about us."

The government sees things differently. While Indonesia remains a poor country, the Suharto regime undeniably, and appreciably, reduced poverty. Government economists say that developing the world's largest palm oil industry will pay off at all levels of society. Until then, the cultural and economic

roots of forest burning run so deep that the government is both unwilling and unable to attempt severing them.

When the smoke began drifting across the South China Sea last summer, inflaming the eyes, lungs, and tempers of Indonesia's neighbors, especially Malaysia and Singapore, officials in Jakarta gave a collective shrug. Their cavalier response was partly explained by the prevailing breezes—the capital itself remained clear, and its residents, including the nation's leaders, were untroubled by what local newspapers blandly referred to as "haze." Indeed, even as Indonesians in the smaller

cities and towns gagged on the foul air, very few complained openly.

Yuchen, a 27-year-old woman wearing a modest black head scarf, was an exception. "It's the rich people," she said, as we chatted aboard a small ferry. "They want to make a lot of money very quickly. So they burn the forest instead of cutting it."

Suharto wasn't being kept up-to-the-minute on the fires of 1997. So common was it for his lieutenants to avoid delivering unsettling news that Indonesians created an abbreviation, ABS, for asal bapak senang,



PLAYING WITH FIRE

AYING WITH FIRE

Despite roadside prohibitions (below) and grim pollution alerts, schoolchildren in Kalimanta Despite roadside pronibitions (below) and simple waste. This ingrained habit plus continuing learn that fire is the handiest tool for cleaning up waste. This ingrained habit plus continuing learn that fire is the nandlest tool for cleaning and learn that fire is the nandlest tool for cleaning and learn that fire is the nandlest tool for cleaning and learn that fire is the nandlest tool for cleaning and learn that fire is the nandlest tool for cleaning and learn that fire is the nandlest tool for cleaning and learn that fire is the nandlest tool for cleaning and learn that fire is the nandlest tool for cleaning and learn that fire is the nandlest tool for cleaning and learn that fire is the nandlest tool for cleaning and learn that fire is the nandlest tool for cleaning and learn that in Indonesia haze will become a chronic fact of life.

meaning "as long as father is happy." Eventually, though, he was compelled to act, and he apologized to neighboring countries. But his expression of regret was little more than Javanese formality. He blamed the haze on an act of God and took no meaningful action. Ironically, Suharto's rare apology sparked a reverse effect: Fearing that the government might stop issuing new land-clearing licenses, plantation operators set even more fires.

The fires coincided with a crisis Suharto had good reason to consider more pressing. The economy was collapsing around him, and world leaders were demanding that he straighten out the currency mess, which eventually led to riots that forced his resignation in May 1998.

In Indonesian culture, particularly the variant refined by Suharto over more than 30 years in power, all actions are ordered by the president or not at all. "The top-down system makes it wise for an official to keep his own counsel," explained a former government attorney. "Initiative can prove harmful to career and personal finance."

So, for example, when we stopped at the government office in Sampit and asked the tan-uniformed officerin-charge where there were fires in the area, he shook his head. "Oh, there aren't any. Burning has been banned hereabouts for months." After



coffee and handshakes, we drove less than five miles, right into a roadside fire. "We've been burning this land for the past four days," said Rosnan bin Lan, a 40year-old widow with four children. "No one from the government told us not to."

It's a basic of everyday life in Indonesia that government workers often turn their backs in return for a bribe. But by the time I flew to Jakarta in mid-October 1997, four months after the fires began, a few officials were angry enough to speak up. Sarwono Kusumaatmadja, the environment minister whose Don Quixote-style struggle for political and bureaucratic reform has earned him quiet admiration for persistence and tongue-clucking pity for his inability to implement change, was one of these.

Sarwono assured me that the bad guys were the big guys—Suharto's friends. He helped draw up a list of 29

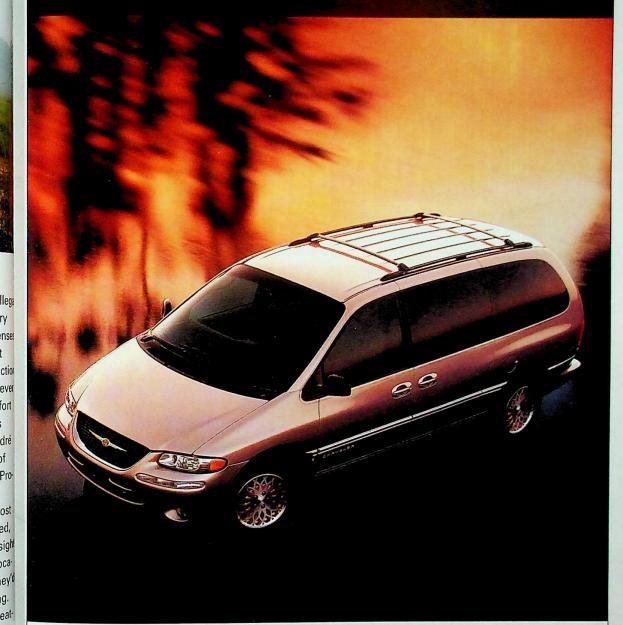
companies that had set illeg fires. The forestry ministry revoked their logging license Yet the operators weren't worried; they knew the action didn't have teeth. "I've never seen any government effort succeed in stopping fires from being set," said André Balot, deputy chairman of the Indonesian Palm Oil Producers Association.

By February 1998, almost as soon as the rains halted, thousands of fires were sigh ed again, some in new loca tions and some where they been smoldering all along. Scientists worry that repeat ed cycles of fire of this magnitude will wreak terrible damage on human and animal life in the region, upsetting ecosystems, killing coff reefs in floods of eroded soil and destroying one of the world's last remaining tropi cal rain forests. Whether the change in government will affect the rate of burning remains an open question.

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POINT OF VIEW

Putting People on Mars

Visiting Florida's Epcot Center in 1981, I put on polarized glasses to view a 3-D movie made by Kodak. During a bucolic scene, dandelion fuzz floated right off the screen to within my reach. That's when I realized the power of threedimensional technology to put the viewer in the picture.

Conveying that sense of place seemed crucial for the Pathfinder mission to Mars. In 1993 my colleagues and I decided to compete for the camera contract. NASA wanted a small, lightweight unit capable, at

Pathfinder

imaging

rocks on

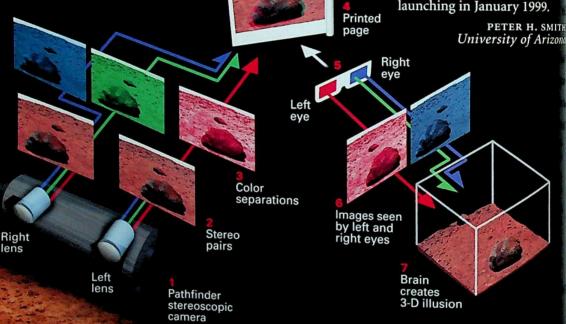
Mains

minimum, of black-and-white imaging. My concept, which came to me in a dream, combined stereoscopic vision with color filters in a compact robotic head. It would have two lenses, six inches apart, working just like human eyes. With 3-D we could measure the distance and size of each rock. Knowing the size distribution of rocks in

a field is critical to determining their origin. Those from an impact crater have different shapes and sizes from those carried downstream by floodwaters. From 3-D images we could also make topographic maps and simulate driving the rover on a computer before giving instructions to the real rover on Mars.

The finely calibrated digital camera, Imager for Mars Pathfinder, recorded 16,661 frames, which we are still analyzing. A similar camera will go to Mars's south polar region on a mission launching in January 1999.

University of Arizona



HOW 3-D IMAGING WORKS

Like your eyes, the camera's left and right lenses see the scene from slightly different angles, causing the position of the distant rock to shift in relation to the foreground rock, a principle called parallax. Images are transmitted to JPL to be processed 28 colored 3—the left, red; the right, blue and green. The images are overlaid as a combined image, or anaglyph, and printed 4. Now look through your 3.0 glasses at the anaglyph. Seen through the red filt the anaglyph presents the left eye with the view through the camera's left lens; through the blue fills the right eye views the right lens's image . The brain's visual center perceives the two as a single three-dimensional true-color image.

ART BY DON FOL

NATIONAL GEOGRAPHIC, AUGUST 1998 CC-0. In Public Domain. Gurukul Kangri Collection, Flaridwar

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SEXUAL HEALTH

Most men will have an isolated erection problem at some time in their lives, but for others it happens more frequently. If the inability to respond naturally to your partner has become a recurring problem, you may be suffering from a treatable medical condition called erectile dysfunction (E.D.), also known as impotence. The following questions and answers are designed to give you a brief introduction to the causes of E.D. and the various treatment options available. If you believe you are suffering from E.D., or want to know more about the condition, talk to your doctor or other healthcare professional.

ERECTION PROBLEMS: WHAT EVERY MAN SHOULD KNOW

WHAT IS E.D.?

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Erectile dysfunction is the consistent inability to achieve and/or maintain an erection sufficient for satisfactory sexual activity. That means not just an occasional problem, but one that has been occurring repeatedly for a period of time. It's a widespread condition, shared by approximately 30 million men in the United States.

WHAT CAUSES E.D.?

It was once believed that E.D. is all in your head, or just an inevitable result of getting older. Actually, the majority of E.D. cases are associated with physical conditions or events, including some that are age-related.

The most common risk factors for E.D. include:

- Diabetes, high blood pressure, hardening of the arteries, or high cholesterol
- Injury or illness, such as spinal cord injury, multiple sclerosis, depression, stroke, or surgery for the prostate or colon
- Medications that may bring about E.D. as an unwanted side effect
- Cigarette smoking or alcohol/drug abuse
- Psychological conditions, such as anxiety and stress

If you want to know more about E.D., talk to your doctor.

CAN ERECTILE DYSFUNCTION BE TREATED?

Yes. The good news is that, regardless of the cause, the vast majority of E.D. cases are treatable. Patients have a variety of treatment options from which to choose, including oral medication, hand-held vacuum pumps, self-administered injections, pellet suppositories, and surgical implants.

CAN ANYONE USE THESE TREATMENTS?

It's important to remember that these treatments are not for everyone, but only for men diagnosed with E.D. You and your doctor can determine the appropriate treatment for you.

HOW DO I KNOW IF I HAVE E.D.?

If you have erection problems, you probably already know it. But before your condition can be treated, you need to get a diagnosis from your doctor. There is no need to be embarrassed or ashamed when discussing E.D. with your doctor. He or she has probably diagnosed and treated E.D. many times but may not

have discussed it with you out of respect for your privacy. Your doctor can provide you with understanding, support, and best of all, information.

To diagnose E.D., doctors typically ask a few specific questions and give a routine physical exam. This should help your doctor arrive at a diagnosis.

Based on this information, you and your doctor will decide on the treatment that is best for you.

REMEMBER:

E.D. is a common medical condition.

It's not an inevitable result of growing older.

E.D. is treatable with a variety of methods.

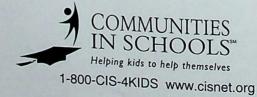
Only your doctor can prescribe the appropriate treatment.



hands need Hands

Gangs. Poverty. Drugs. Broken homes. With obstacles like these, kids today need extra help to stay in school. Sometimes it's tutoring in reading or a community drug awareness class. It can be volunteer professional services, like a doctor for vision screenings, or school-to-career workshops. Often the need is for computers and training for modern technology classes... or just someone to be a mentor to a troubled kid.

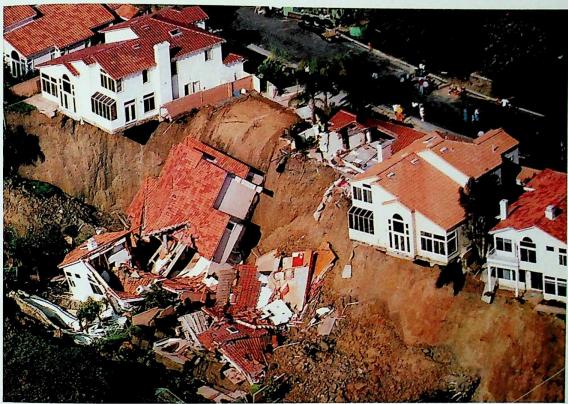
When a young person reaches out, Communities In Schools brings that hand together with hands from the community that can help.



fil

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OnTelevision



GERALDINE WILKINS-KASINGA, LOS ANGELES TIMES

■ EXPLORER, AUGUST 23 When Earth Lets Go

By March 19, 1998, more than 24 inches of rain had fallen on Laguna Niguel, south of Los Angeles. That was nearly twice the seasonal average. Anxious residents watched as El Niñodriven rains saturated the soil of an artificial hill where expensive homes had been built above a condominium complex.

Recorded in EXPLORER's new film "Landslide!," the collapse that had been predicted for years by geologists finally happened, sending two homes crashing onto a terraced slope (above) and destroying five of the condos at the bottom of the hill.

The houses and demolished condos, earlier judged the most

imperiled by the hill, had been evacuated in December. But residents in other units remained worried. The day before the landslide fire trucks and police cars were stationed nearby and engineers kept watch. About 3 a.m. residents were awakened and told to evacuate immediately. No one was injured.

On the other side of the globe, the Alpine sky shines a brilliant blue and sunlight sparkles on snow. The danger beneath this beauty breaks loose with a low rumble in "Thunder on the Mountain," as great slabs of snow come to life and gather speed, hurtling down to bury anything—and anybody—in the way.

Computer animation illustrates the hidden dynamics of

avalanches, set in motion by a variety of often unpredictable conditions. The film follows scientists at the Swiss Federal Institute for Snow and Avalanche Research as they examine the physics of snow structure.

Together the EXPLORER films show the human costs when Earth's soil or its winter blanket moves with sudden and unstoppable force.

■ PROGRAM GUIDE

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To: Everyone From: Larry Stopczynski



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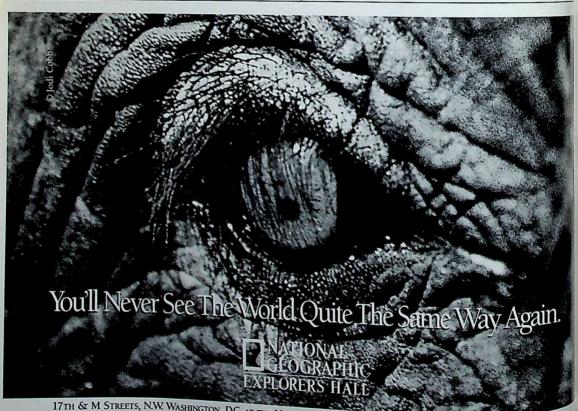
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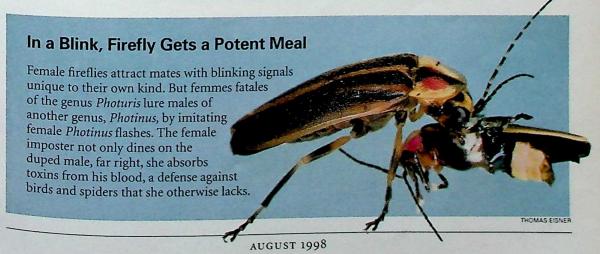
A Wild Wind Roared Out West

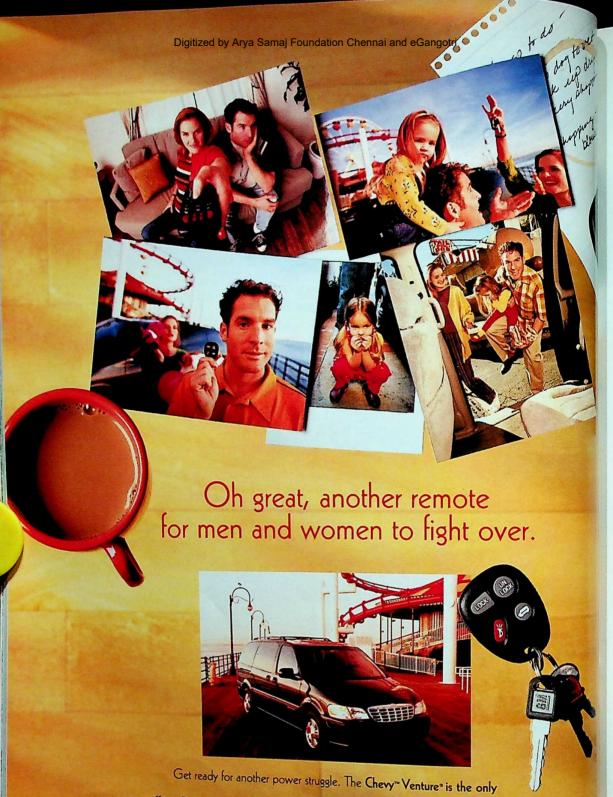
ific, ects igth still ive,

When the sun rose last October 25 over Routt National Forest northwest of Denver, it revealed an amazing sight. In the dead of night a violent freak storm with 120-mile-an-hour winds had leveled five million Engelmann spruce and subalpine fir trees. Such blowdowns typically cover 50 to 100 acres. This one flattened about 20,000 acres—more

than 30 square miles. "The scope is just phenomenal," says Frank Cross of the U.S. Forest Service.

What to do with some 200 million board feet of downed timber? That's the service's dilemma. About 60 percent lies within the Mount Zirkel Wilderness Area, where logging is prohibited. About 3,000 acres outside the wilderness may be logged. One big concern: The dead trees may attract millions of destructive spruce bark beetles.





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PERRY THORSVIK, BALTIMORE SUN (TOP); MARIA CECIL, DEFENDERS OF WILDLIFE

Swans Follow Man's Wings to Find the Way Home

A trio of female trumpeter swans—Isabelle, Yoyo, and Sydney—touched down with an ultralight at Magruder Ferry, Maryland, last December 18. After overnighting, the swans completed their 103-mile flight to a Chesapeake Bay farm, their new winter home. They began near Airlie, a Virginia research center where the swans were imprinted on ultralights and humans. Researchers played a recording of a plane's engine to them before they hatched. Here biologist Kevin Richards reinforces the bond.

The flight was a real-life reel from Fly Away Home, the movie that featured earlier work with Canada geese used as test birds with ultralights

before the swans were tried. The long-term project, recently a collaboration between Airlie zoologist Bill Sladen and Defenders of Wildlife, seeks to reestablish migratory trumpeters in the eastern U.S., where they numbered 100,000 until settlers wiped them out by the mid-19th century. In Alaska and the West some 20,000 trumpeters remain. Researchers are trying to teach some birds the old migration route between Ontario and Maryland. "This fall we hope to truck some Airlie-raised swans to a site in New York State, train them to fly alongside an ultralight, and then lead them down to the Chesapeake Bay," says Sladen. "If they return to New York next spring and then migrate to the Chesapeake on their own next fall, that will be the ultimate success."

TEXT BY JOHN L. ELIOT

Chennal and eGangotri

A pill that helps men with erectile dysfunction respond again.



Please see brief summary of product information for VIAGRA (25-mg, 50-mg, 100-mg) tablets on the following page

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Now there's a simple new pill for the treatment of erectile dysfunction (a common medical problem also called impotence).

VIAGRA** (sildenafil citrate) is a prescription pill that may help you achieve erections the natural way—in response to sexual stimulation.

Naturally, the response has been positive.

With VIAGRA, you may be able to respond naturally once again—with the ease of a pill. Ask your doctor if VIAGRA is the right step for you.

VIAGRA should not be taken by men who use drugs known as nitrates (most often used to control angina) in any form, at any time. Nitrates can reduce blood pressure to unsafe levels if used with VIAGRA. Be sure to talk to your doctor about any medications you take.

In clinical trials, VIAGRA was well tolerated. Some men experienced side effects, including headache, facial flushing, and upset stomach. A small percentage of men experienced mild and temporary visual effects. (See product information for more details.) For more information, call 1-888-4VIAGRA or visit www.viagra.com.

(sildenafil citrate) tablets
Let the dance begin.

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Brief summary of prescribing information

VIAGRA (sildenafil citrate) tablets

INDICATION AND USAGE
VIAGRA is indicated for the treatment of erectile dysfunction. The studies that established benefit demonstrated improvements in success rates for sexual intercourse compared with

CONTRAINDICATIONS

Use of VIAGRA is contraindicated in patients with a known hypersensitivity to any component of the tablet. Consistent with its known effects on the nitric oxide/cGMP pathway (see CLINICAL PHARMACOLOGY). VIAGRA was shown to potentiate the hypotensive effects of nitrates, and its administration to patients who are concurrently using organic nitrates in any form is therefore contraindicated.

PRECAUTIONS

A thorough medical history and physical examination should be undertaken to diagnose erectile dysfunction, determine potential underlying causes, and identify appropriate treatment.

There is a degree of cardiac risk associated with sexual activity; therefore, physicians may

wish to consider the cardiovascular status of their patients prior to initiating any treatment for erectile dysfunction.

Agents for the treatment of erectile dysfunction should be used with caution in patients with anatomical deformation of the penis (such as angulation, cavernosal fibrosis or Peyronie's disease), or in patients who have conditions which may predispose them to priapism (such as sickle cell anemia, multiple myeloma, or leukemia).

The safety and efficacy of combinations of VIAGRA with other treatments for erectile dysfunction have not been studied. Therefore, the use of such combinations is not

dysfunction have not been studied. Therefore, the use of such combinations is not recommended.

VIAGRA has no effect on bleeding time when taken alone or with aspirin. In vitro studies with human platelets indicate that sildenafil potentiates the antiaggregatory effect of sodium nitroprusside (a nitric oxide donor). There is no safety information on the administration of VIAGRA to patients with bleeding disorders or active peptic ulceration. Therefore, VIAGRA should be administered with caution to these patients.

A minority of patients with the inherited condition retinitis pigmentosa have genetic disorders of retinal phosphodiesterases. There is no safety information on the administration of VIAGRA to patients with retinitis pigmentosa. Therefore, VIAGRA should be administered with caution to these patients.

Information for Patients

Physicians should discuss with patients the contraindication of VIAGRA with concurrent

Physicians snown of uscuss with patients the communication of vincins and of organic nitrates.

The use of VIAGRA offers no protection against sexually transmitted diseases. Counseling of patients about the protective measures necessary to guard against sexually transmitted diseases, including the Human Immunodeficiency Virus (HIV), may be

Drug Interactions

Effects of Other Drugs on VIAGRA

Effects of Other Drugs on VIAGHA
In vitro studies: Sildenafil metabolism is principally mediated by the cytochrome P450
(CYP) isoforms 3A4 (major route) and 2C9 (minor route). Therefore, inhibitors of these isoenzymes may reduce sildenafil clearance.

In vivo studies: Cimetidine (800 mg), a non-specific CYP inhibitor, caused a 56% increase in plasma sildenafil concentrations when co-administered with VIAGRA (50 mg) to healthy volunteers.

In vivo studies: currending tooching, in plasma sildenafil concentrations when co-administered with VIAGRA (50 mg) to meaning in plasma sildenafil concentrations when co-administered with erythromycin, a specific CYP3A4 inhibitor, at steady state (500 mg bid for 5 days), there was a 182% increase in sildenafil systemic exposure (AUC). Stronger CYP3A4 inhibitors such as ketoconazole, itraconazole or mibefradii would be expected to have still greater effects, and population data from patients in clinical trials did indicate a reduction in sildenafil clearance when it was co-administered with CYP3A4 inhibitors (such as ketoconazole, erythromycin, or cimetidine). It can be expected that concomitant administration of CYP3A4 inducers, such as rifampin, will decrease plasma levels of sildenafil. Single doses of antacid (magnesium hydroxide/aluminum hydroxide) did not affect the bioavailability of VIAGRA. Pharmacokinetic data from patients in clinical trials showed no effect on sildenafil pharmacokinetics of CYP2O9 inhibitors (such as selective serotonin reuptake inhibitors, tricyclic antidepressants), thiazide and related diuretics, ACE inhibitors, and calcium channel blockers. The AUC of the active metabolite, N-desmethyl sildenafil, was increased 62% by loop and potassium-sparing diuretics and 102% by non-specific beta-blockers. These effects on the metabolite are not expected to be of clinical consequence.

Effects of VIAGRA on utner urugs In vitro studies: Sidenafil is a weak inhibitor of the cytochrome P450 isoforms 1A2, 2C9, 2C19, 2D6, 2E1 and 3A4 ($(150 > 150 \, \mu M)$). Given sidenafil peak plasma concentrations of approximately 1 μM after recommended doses, it is unlikely that VIAGRA will alter the clearance of substrates of these isoenzymes. In vivo studies: No significant interactions were shown with tolbutamide (250 mg) or warfarin (40 mg), both of which are metabolized by CYP2C9. VIAGRA (50 mg) did not potentiate the increase in bleeding time caused by aspirin (150 mg).

VIAGRA (50 mg) did not potentiate the increase in bleeding time caused by aspirin (150 mg).
VIAGRA (50 mg) did not potentiate the hypotensive effect of alcohol in healthy volunteers with mean maximum blood alcohol levels of 0,08%.
No interaction was seen when VIAGRA (100 mg) was co-administered with amlodipine in hypertensive patients. The mean additional reduction on supine blood pressure (systolic, 8 mHg; diastolic, 7 mmHg) was of a similar magnitude to that seen when VIAGRA was administered alone to healthy volunteers (see CLINICAL PHARMACOLOGY).
Analysis of the safety database showed no difference in the side effect profile in patients taking VIAGRA with and without anti-hypertensive medication.
Carcinogenesis, Mutagenesis, Impairment of Fertility
Sildenafil was not carcinogenic when administered to rats for 24 months at a dose resulting in total systemic drug exposure (AUCs) for unbound sildenafil and its major metabolite of 29- and 42-times, for male and female rats, respectively, the exposure observed in human males given the Maximum Recommended Human Dose (MRHD) of 100 mg. Sildenafil was not carcinogenic when administered to mice for 18-21 months at dosages up to the Maximum Tolerated Dose (MTD) of 10 mg/kg/day, approximately 0.6 times the MRHD on a mg/m² basis.

Sildenafil was negative in *in vitro* bacterial and Chinese hamster ovary cell assets detect mutagenicity, and *in vitro* human lymphocytes and *in vivo* mouse micro.

detect mutagementy, and in with funding hymphocytes and in vivo mouse micro-assays to detect clastogenicity.

There was no impairment of fertility in rats given sildenafil up to 60 mg/gs and 36 days to females and 102 days to males, a dose producing an AUC value of more times the human male AUC.

mes the human male AUC. There was no effect on sperm motility or morphology after single 100 mg oral doc VIAGRA in healthy volunteers.

Pregnancy, Nursing Mothers and Pediatric Use VIAGRA is not indicated for use in newborns, children, or women

VIAGRA is not indicated for use in newborns, children, or women.

Pregnancy Category B. No evidence of teratogenicity, embryotoxicity or fetotocobserved in rats and rabbits which received up to 200 mg/kg/day during organos. These doses represent, respectively, about 20 and 40 times the MRHD on a mg/m a 50 kg subject. In the rat pre- and postnatal development study, the no observed effect dose was 30 mg/kg/day given for 36 days. In non-pregnant rats the AUC at me was about 20 times human AUC. There are no adequate and well-controlled st. Spoiled sildenafil in pregnant women.

ADVERSE REACTIONS

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VIAGRA was administered to over 3700 patients (aged 19-87 years) during clinical st. \$749 worldwide. Over 550 patients were treated for longer than one year. In placebo-controlled clinical studies, the discontinuation rate due to adverse each 98 Adverse generally transient and mild to moderate in nature.

were generally transient and mild to moderate in nature.

In trials of all designs, adverse events reported by patients receiving VIAGRA Uring I generally similar In fixed-dose studies, the incidence of some adverse events mover with dose. The nature of the adverse events in flexible-dose studies, which mover reflect the recommended dosage regimen, was similar to that for fixed-dose studies. When VIAGRA was taken as recommended (on an as-needed basis) in flexible make placebo-controlled clinical trials the following adverse events were reported:

TABLE 1. ADVERSE EVENTS REPORTED BY ≥2% OF PATIENTS TREATED WITH VIAGRA AND MORE FREQUENT ON DRUGTHI PLACEBO IN PRN FLEXIBLE-DOSE PHASE II/III STUDIES

Adverse Event	Percentage of Pa VIAGRA N=734	atients Reporting Event PLACEBO N=725
Headache	16%	4%
Flushing	10%	1%
Dyspepsia	7%	2%
Nasal Congestion	4%	2%
Urinary Tract Infection	3%	2%
Abnormal Vision	3%	0%
Diarrhea	3%	1%
Dizziness	2%	1%
Rash	2%	1%

Abnormal Vision: Mild and transient, predominantly color tinge to vision, but also increased sensit light or blurred vision. In these studies, only one patient discontinued due to abnormal vision.

Other adverse reactions occurred at a rate of >2%, but equally common on page

Other adverse reactions occurred at a rate of >2% but equally common respiratory tract infection, back pain, flu syndrome, and arthralgia. In fixed-dose studies, dyspepsia (17%) and abnormal vision (11%) were more at 100 mg than at lower doses. At doses above the recommended dose range and events were similar to those detailed above but generally were reported more frequently.

events were similar to those detailed above but generally were reported more frequency. No cases of priapism were reported.

The following events occurred in < 2% of patients in controlled clinical trials; az relationship to VIAGRA is uncertain. Reported events include those with a plausble rest to drug use, omitted are minor events and reports too imprecise to be meaningful.

Body as a whole: face edema, photosensitivity reaction, shock, asthenia, pain, of accidental fall, abdominal pain, allergic reaction, chest pain, accidental injury.

Cardiovascular: angina pectoris, AV block, migraine, syncope, tachycardia, pain of a creation, postural hypotension, myocardial ischemia, cerebral thrombosis, carrest, heart failure, abnormal electrocardiogram, cardiomyopathy.

Digestive: vomiting, glossitis, colitis, dysphagia, gastritis, gastroenteritis, esophy, temic and Lymphatic: anemia and leukopenia.

Metabolic and Nutritional: thirst, edema, gout, unstable diabetes, hypergischeral edema, hyperunicemia, hypoglycemic reaction, hypernatremia.

Musculoskeletal: arthritis, arthrosis, myalgia, tendon rupture, tenosynovitis, book myasthenia, synovitis.

myasthenia, synovitis.

Nervous: ataxia, hypertonia, neuralgia, neuropathy, paresthesia, tremo, te depression, insomnia, somnolence, abnormal dreams, reflexes decreased, hypesthesi Respiratory: asthma, dyspnea, laryngitis, pharyngitis, sinusitis, bronchils, sincreased, cough increased.

Skin and appendages: urticaria, herpes simplex, pruritus, sweating, skin ulcer to dermatitis, exfoliative dermatitis.

Special senses: mydriasis, conjunctivitis, photophobia, tinnitus, eye pain, dealness pain, eye hemorrhage, cataract, dry eyes.

Urogenita: cystitis, nocturia, urinary frequency, breast enlargement, urinary incomparability in the properties of the proper

In studies with healthy volunteers of single doses up to 800 mg, adverse events similar to those seen at lower doses but incidence rates were increased. In cases of overdose, standard supportive measures should be adopted as reproteins and it is not eliminated in the urine.

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CANADA'S ATLANTIC COAST



Large image: Stand at the most easterly point in the Western World - Cape Spear, Newfoundland - and be the first to greet the new day. Small inset image: Watch for migrating rare seabirds from the famoured sand-stone cliffs of Prince Edward Island.

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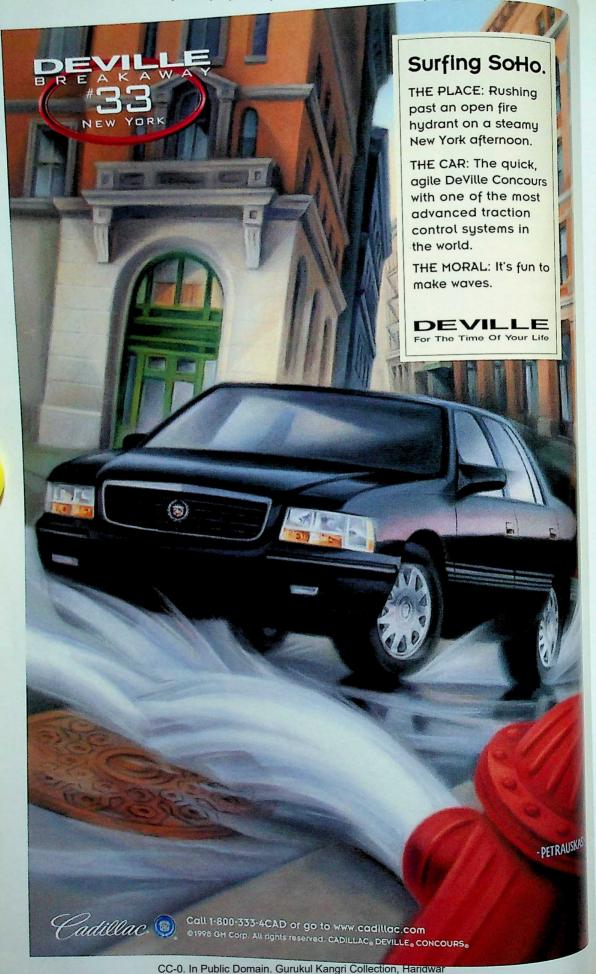
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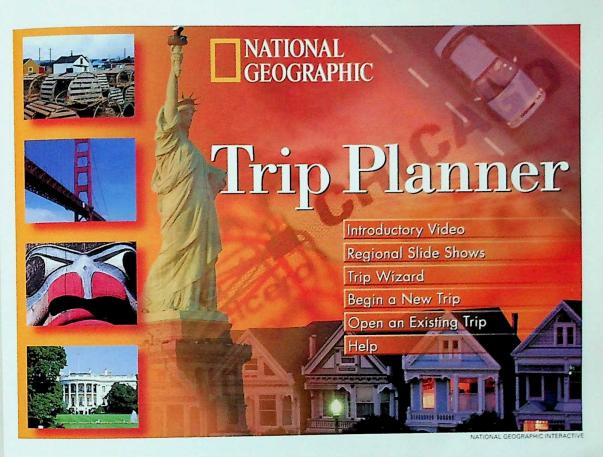
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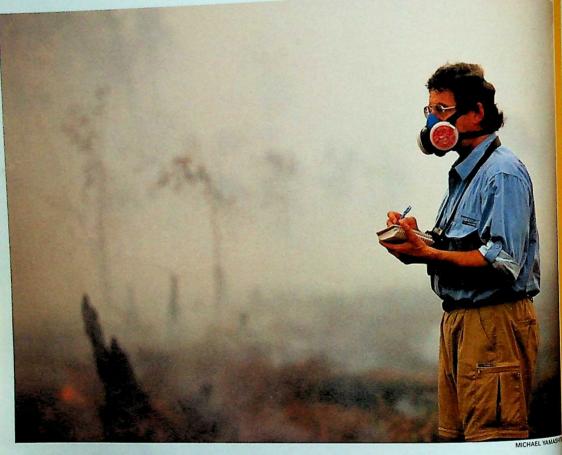
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■ INDONESIA FIRES **Breathless Reporting**

"Sometimes the smoke was too thick to see more than a few yards ahead," says writer Lew Simons, who covered Indonesia's fires with photographer Mike Yamashita. Mike-a volunteer fireman back home in New Jersey-brought the respirators he and Lew wore constantly. "It never occurred to me that we'd need masks," admits Lew. "But we couldn't have worked without them." A New Jersey native, Lew has spent three decades writing about Asia. While Tokyo bureau chief for Knight-Ridder Newspapers, he won a Pulitzer for his reporting on the Philippines.

■ NEW YORK'S CHINATOWN

East Side Story

He's written about subjects from Burma to the brain. But for Assistant Editor Joel Swerdlow, here with Fifth Precinct Deputy Inspector Thomas Chan, reporting on Chinatown was still a tough assignment. "A lot of people didn't want to talk," he says. "They worry about immigration officials and safety inspectors. Outsides like me are trouble."



Chinese photographer Chien-Chi Chang eased Joel's way, as did the universal language of food. "Chinatown's rataurants are great," Joe says. "But sometimes, for a change, I'd take my Chinese friends a few blocks away for dinner in Little Italy.

Still, working with

VOL. 194, NO. 3

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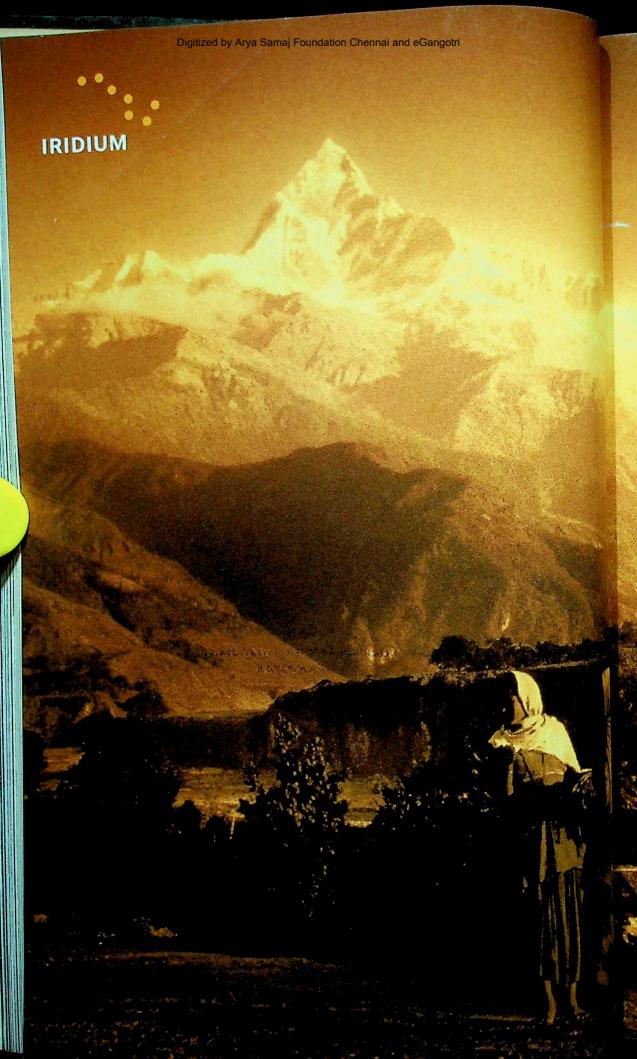


SEPTEMBER 1998

NATIONAL GEOGRAPHIC

A NEW DAY FOR ROMANIA 34
GREENLAND SHARKS 60
VERMONT: SUITE OF SEASONS 72
CATHERINE THE GREAT 92
BORNEO'S WHITE MOUNTAIN 118

VALLEY OF THE KINGS



EHANGES.

THE WATER CHANGES, THE LANGUAGE CHANGES.

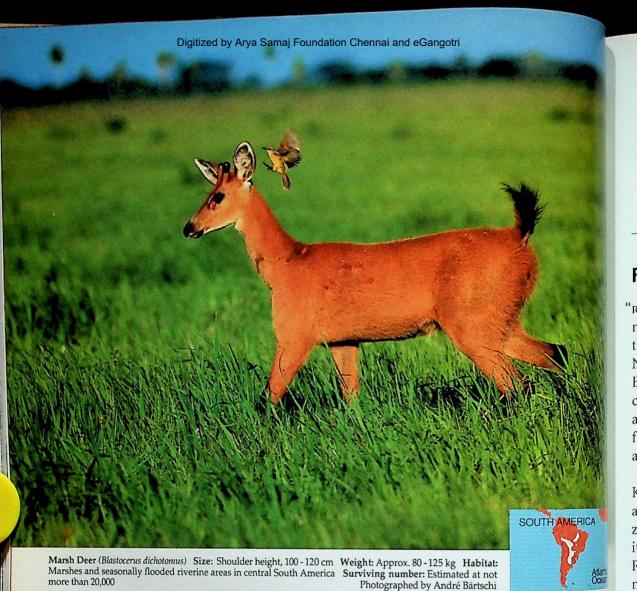
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WILDLIFE AS CANON SEES IT

On a Bolivian savanna, a young male marsh deer enjoys the fresh grass generated by seasonal rains, while a tyrant flycatcher snatches insects stirred up by the deer. Built for jumping, marsh deer have thin legs and strong haunches; long hooves, with spreading toes, facilitate travel on soft ground. Large preorbital scent glands near the eye are a distinct feature of marsh deer, as are their

Habitat destruction, hunting pressures at high susceptibility to cattle diseases contribute to the rarity of this largest of Sout American deer. As a global corporation committed to social and environment concerns, we join in worldwide efforts promote greater awareness of endangers species for the benefit of future generation

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NATIONAL **GEOGRAPHIC**

From the Editor

"RECENT DISCOVERIES IN EGYPT have carried the record of Egyptian civilization back....before the building of the pyramids," we wrote in NATIONAL GEOGRAPHIC'S first article about Egypt, in the November 1901 issue. Nearly a century of Society-sponsored research and magazine articles covering the work of Egyptologists from around the world have since then woven an ever richer tapestry of life in ancient Egypt.

From our article describing the opening of King Tutankhamun's tomb to our re-creation of ancient Egyptian baking techniques, the magazine has published some 60 stories about Egypt, its history, and its people. Our Committee for Research and Exploration has helped support more than 80 Egyptian studies and expeditions.

Many of the authors, photographers, and scientists whose work in Egypt has been reported in the GEOGRAPHIC have embarked on adventures worthy of Indiana Jones

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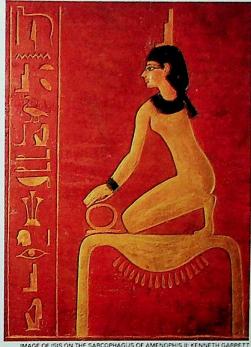
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himself—and none more so than Kent Weeks, professor of Egyptology at the American University in Cairo. In July 1989 he crawled through an obscure tomb entrance and found himself in the largest burial place ever discovered in the Valley of the Kings. His article and Kenneth Garrett's photographs this month—which detail the first excavation of the tomb since British surveyor James Burton located it in 1825—would have been impossible without the generous cooperation of Egypt's Supreme Council of Antiquities. Equally invaluable Egyptian government assistance in 1987 enabled us to lower cameras into a sealed chamber beside the Great Pyramid of Khufu and find a disassembled funerary boat.

The ancient Egyptians left countless reminders of their culture buried in the sand. So long as scientists keep digging up new artifacts and shedding new light on old ones, NATIONAL GEOGRAPHIC will relay their findings to a world that seems perpetually fascinated with the realm of the pharaohs.

Bill allen

In life they ruled like gods. In death the pharaohs of ancient Egypt's New Kingdom were united with their deities. Decades of excavation in the necropolis (right) near Luxor have turned up treasures like Tutankhamun's gold mask (below), along with insight into the soul of a dead civilization.

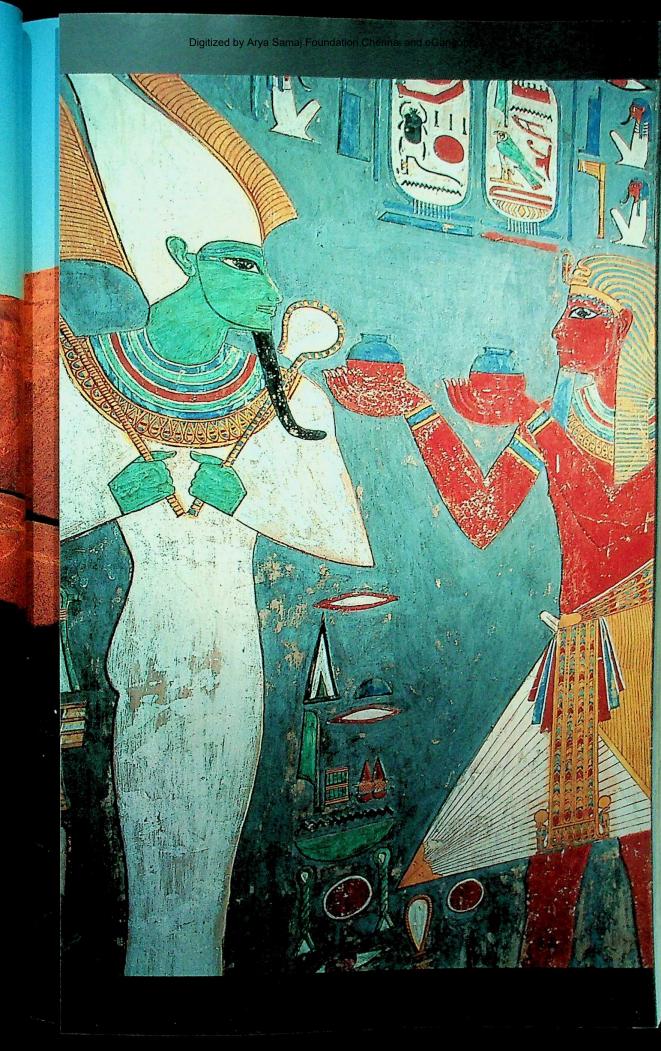


VALLEY OF THE KINGS

By KENT R. WEEKS

Photographs by KENNETH GARRETT

Art by CHRISTOPHER A. KLEIN



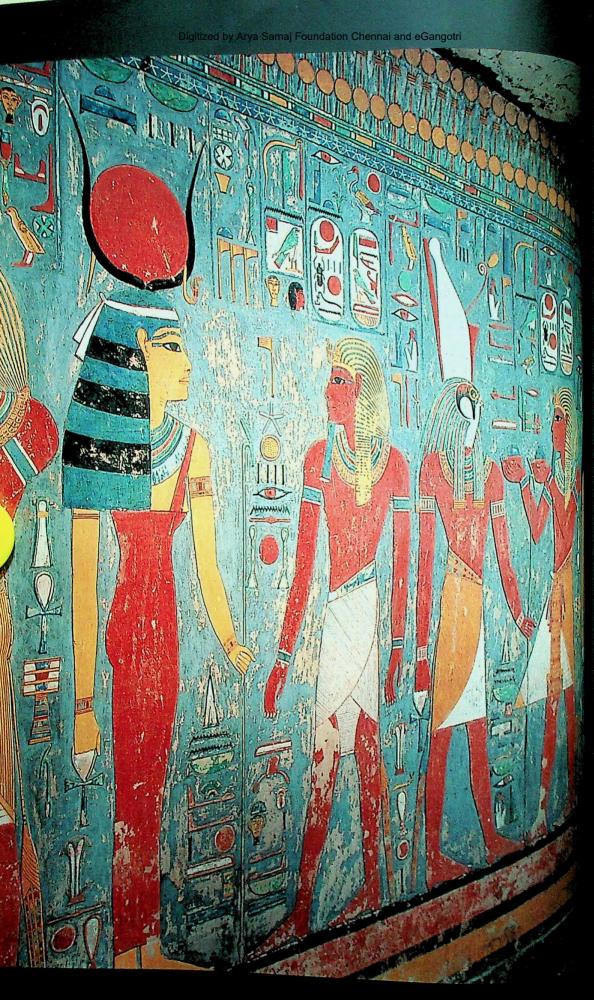




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(top king from next Egyp the s shine would Chap



Tale of his life Horer ruled 1319 in makes offering and Hornata (top) king jump from a Egypt the sushine, would Chaos



Tale of a tomb: In his life after death, Horemheb, who ruled Egypt from 1319 to 1292 B.C., makes a ritual offering of wine to Osiris, god of the afterlife. Murals, mummification, and Horemheb's ornate sarcophagus (top) all helped the king journey safely from this life to the next. Otherwise, Egyptians believed, the sun would not shine, the moon would not rise. Chaos would reign.

O ONE HAD VENTURED inside the ancient Egyptian tomb since 1825, when a British traveler and draftsman named James Burton sketched its first few chambers. It lay somewhere near the entrance to the Valley of the Kings—burial place of New Kingdom pharaohs who ruled Egypt at the peak of its military power, between 1539 and 1078 B.C.

In 1827 John Gardner Wilkinson, one of the founders of Egyptology, designated the tomb KV 5—the fifth tomb beyond the entrance to KV, the Kings' Valley. Then for more than 150 years KV 5 was all but forgotten.

In 1989 I was directing a mapping project in the Valley of the Kings, and I wanted to relocate KV 5, not because it held treasures—it didn't—but because the roadway at the valley's entrance was being widened. The roadwork seemed likely to damage any tomb in its path, and that path, I believed, lay right above KV 5.

The tomb has turned out to be the largest ever found in the Valley of the Kings. It was a family mausoleum—the burial place of many of the sons of Ramses II. It contains at least 110 chambers, and its artifacts and hieroglyphs promise to change what we know about Ramses II, one of antiquity's most powerful rulers. During his long reign ancient Egypt controlled lands from present-day Sudan northeast into Syria. Of all the pharaohs he was the most prolific builder. To glorify his name, Ramses erected dozens of imposing temples and monuments along the Nile.

On a hot Tuesday morning in July 1989 our workmen began digging just east of the roadway. With crude homemade hoes they scraped away debris and carted it off in baskets made of old automobile tires—standard archaeological equipment in Egypt. A week of digging

revealed traces of a tomb entrance. We coulse that a narrow trench had been cut through the debris clogging the tomb's doorway. Jame Burton, I recalled, had dug just such a trench

Assistant excavation director Catharin Roehrig, senior workman Muhammad Mahmoud, and I squeezed into the trench painfully pulling and pushing ourselves over thousands of sharp limestone fragments. To our left and right the tomb was packed nearly to the ceiling with silt and limestone chip washed in by flash floods.

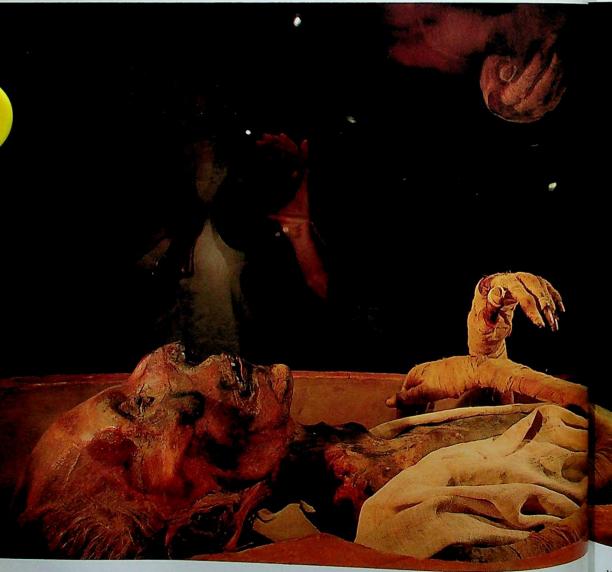
According to Burton's sketch, the third chamber was a cavernous pillared hall. Almost on cue, as we crawled along the trench, we could see the broken tops of massive pillars jutting up through the debris. The trench made sharp turn to the right to avoid a pillar, then began weaving between two- and three-ton

slabs ceiling collaps fallen headli gists F

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slabs of limestone that had fallen from the ceiling. No part of the ceiling appeared to have collapsed since Burton's visit in 1825, but the fallen blocks were unnerving nevertheless. A headline flashed through my mind: "Egyptologists Flattened as Tomb Collapses. Pharaoh's Curse Returns."

After 20 minutes in the stifling heat we were ready to leave. Soaking wet, sweat streaking my glasses, covered in mud, and with my flashlight fading, I turned to Muhammad. "Do you remember where the entrance is?"

"No."

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Catharine wasn't sure either. The hall was so filled with debris that we couldn't see more than a few inches in any direction.

"I think we came in from over there," Muhammad said. He crawled forward, looking for a recognizable pillar or scrape in the debris

> Looking good for his age, the mummified remains of Ramses II, once entombed in the Valley of the Kings, now lie in state at the Egyptian Museum in Cairo. Ruling for 66 years, Ramses built more temples and monuments than any other pharaoh. He had numerous wives and concubines; he sired scores of children and outlived many of them, Recent evidence shows that Ramses' sons were buried in an extraordinary communal tomb.

that would show where we'd been. Shining his flashlight around the chamber, he looked up at the ceiling for a moment, then called us over.

"Look," he said. Directly above him we could see crude black letters written with the smoke of a candle: BURTON 1825.

After a few more wrong turns we clambered out of the tomb. Catharine scraped mud from her clothes, wondering aloud about the tomb's original occupants. "Remember Elizabeth Thomas? She thought this might be a tomb for children of Ramses II. Thomas didn't have any proof, but she knew more about the Valley of the Kings than any other Egyptologist in this century. Her theory should be checked out."

when I was eight, my interest in an ancient civilization winning out over dreams of intergalactic travel. Although my parents never tried to dissuade me from so unlikely a career, one aunt regularly pointed out that an interest in ancient Egypt couldn't possibly lead to a decent job. My friends, on the other hand, agreed that cutting open mummies and searching gold-filled tombs were worthy goals.

Not long after I took my Ph.D. in Egyptology from Yale, the Oriental Institute at the University of Chicago made me director of its field headquarters in Luxor, the modern town built atop ancient Thebes. Surrounded by so many tombs and temples, I had a wonderful opportunity to delve into the archaeology of the New Kingdom—Egypt's golden imperial age.

The warrior pharaohs of the New Kingdom conquered Palestine and Syria with horse-drawn chariots and other advanced military techniques. For three centuries Egypt was the strongest nation in the world. At Thebes the pharaohs built larger and grander temples to proclaim the might and wealth that made their religious capital "the queen of cities . . . greater than any other city." The city proper stood on the east bank of the Nile; the necropolis, with its royal temples and rock-cut tombs, lay on the west.

On weekends I would take a ferry across the Nile, rent a bicycle or hire a taxi, and head off to the well-known sites. When I began looking for the more obscure monuments, I often couldn't find them.

"I'd like to see the tomb of so-and-so," I'd say to one of the antiquities inspectors.



VALLEY OF THE KINGS



Stuck between a rock and a hard place, author Kent Weeks (in hat) and his excavation foreman. Ahmed Mahmoud Hassan, examine a tomb known as KV 5, rediscovered in 1989. Recurrent flash floods have packed the tomb will

aebris, central way at



debris, which engineers concluded was the only thing holding up the roof in the central chamber. Postponing further excavation here, Weeks investigated a doorway at the back of this pillared hall. "We wondered what lay on the other side."

"I've heard of it," he'd reply. "Do you know where it is?"

"Don't you know where it is?"

"No. The old guard Sheikh Taya, he probably knew, but he died."

Of the tombs crowding the Theban necropolis, few had been mapped by the early 1970s. It was easy to see why: In a foursquare-mile strip between the desert mountains and the Nile floodplain lie thousands of tombs, temples, shrines, palaces, and villages-more than in any other part of Egypt, probably more than anywhere else in the world. In some places the tombs are so close together you can crawl from one into another, moving hundreds of feet underground before returning to the surface. In the Valley of the Kings alone, more than half of the tombs are still largely unexcavated—and the burial places of several New Kingdom pharaohs have yet to be found.

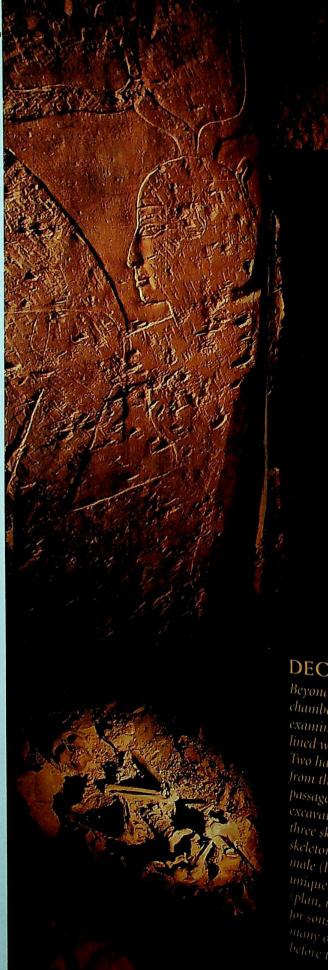
The need for a comprehensive map of Thebes struck me as urgent, and I decided to do something about it.

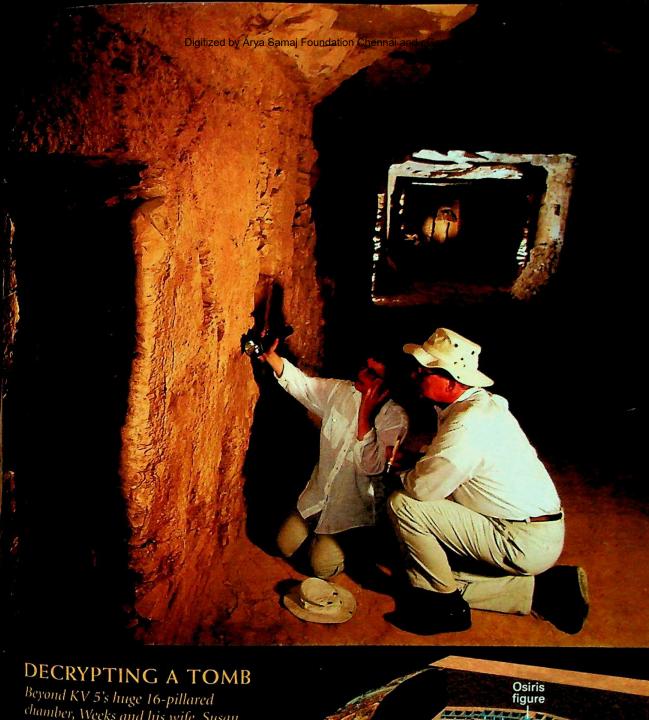
APPING the Theban necropolis entirely from the ground would take my team decades. Aerial photographs would save time. In 1982 we made the first ever hot-air balloon flight over Thebes. Never before had I seen anything more beautiful than the necropolis at sunrise from a thousand feet in the air. The bright, early morning light slanted across the landscape, and we photographed Thebes from angles rarely seen before. Though our flight lasted only an hour, we shot more than 20 rolls of film.

We could hear every sound on the ground. Dogs barked incessantly as the noise of our burner disturbed their sleep. Villagers emerged from their homes as we floated overhead, looking up in amazement, saying over and over, "My God! God is great! My God!"

As we landed, a blue pickup sped toward the site. The local police chief got out and walked toward us. In our excitement we had failed to inform him of our flight.

KENT R. WEEKS is director of the Theban Mapping Project and professor of Egyptology at the American University in Cairo. This article is adapted from his forthcoming book, *The Lost Tomb*. KENNETH GARRETT photographs archaeological subjects all over the world.

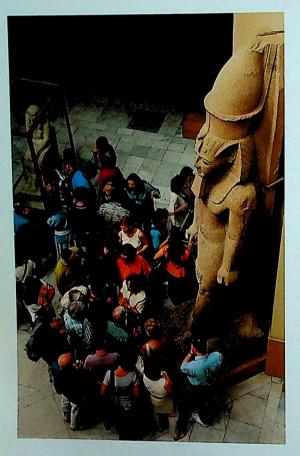






"Why didn't you tell me what you were doing?" he demanded angrily. "Hussein, the schoolteacher, thought you came to invade Egypt. He wanted to shoot you down, and I had to confiscate his gun. This is very bad."

"We are very sorry, sir," I said. "I assure you we did not mean to ignore you. You are the



Pharaohs only rarely commissioned art that featured their children, but Ramses II decorated many temples with images of his sons and daughters. On the walls of his royal temple (right) outside the valley, his sons form a procession beneath their father, who faces the god Amun-Re. Ramses' son Merneptah inherited the throne, and today his monuments (left, at right) draw crowds just as his father's do.



most senior official in this village, and your cooperation is very important to our project. Would you like to come up in the balloon tomorrow? We could show you our work."

The police chief smiled. "That would be very nice. Yes, I will meet you at sunrise. And do not worry about the schoolteacher. I told him that you were not the enemies of Egypt."

HAD ASSUMED that making architectural plans of the tombs in the Valley of the Kings would be a simple task. How complex could tombs be that had been surveyed with a carpenter's square, plumb bob, and piece of string and then carved with chert axes and copper chisels? My team of architects and surveyors, on the other hand, had state-of-the-art equipment and a high degree of naive, can-do cockiness.

We seriously underestimated the ancient Egyptians. Tombs we thought could be easily plotted from, say, 500 measurements, often required thousands; tombs we thought could be mapped in a few days took weeks.

Just crawling into the tombs was difficult. It avoid damaging plastered walls and mummie that lay half-buried in debris, we wriggled in pitch-black spaces barely wide enough for our shoulders. Sometimes we would startle a sleet ing desert fox or dozens of bats hanging from the ceiling.

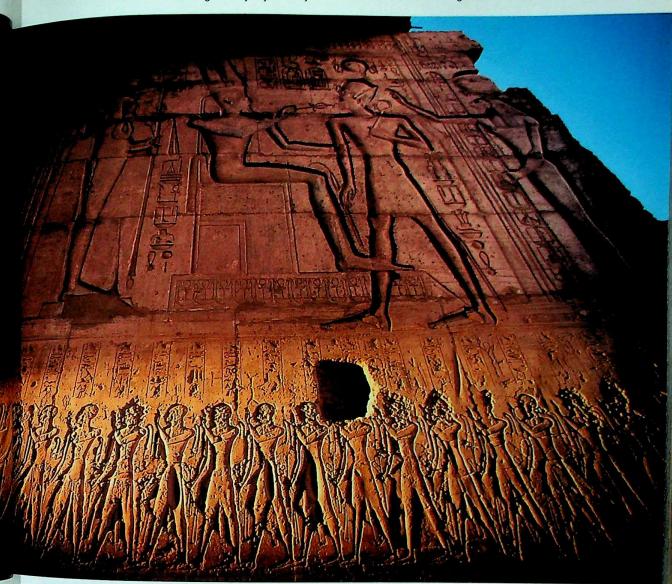
The men who dug the royal tombs live about a mile south of the Valley of the Kings. Their village, Deir el-Medina, offers fascinating glimpse into everyday Egyptialife. From thousands of inscribed limeston fragments called ostraca—the Post-it note of ancient Egypt—we know the names of the

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Mor el-Med woodw terers. in near a lane to pass guests and a statueti

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VALLEY



residents. We know where they lived, when they died, and where they were buried. We even know when they took ill or went on holiday, what they ate, and what they bought and sold.

More than three thousand years ago Deir el-Medina was home to a hundred sculptors, woodworkers, quarrymen, painters, and plasterers. They lived with their wives and children in nearly 70 single-story houses strung along a lane hardly wide enough for two donkeys to pass. Each house had rooms for receiving guests and for sitting and sleeping, a kitchen, and a shaded roof terrace. Wall niches held statuettes of household deities.

In small cellars the workmen stored food they received as payment for their services. What were they paid? An ostracon from the mayor of Thebes to the crew foremen gives the answer: "Please have the wages delivered to the necropolis crew comprising vegetables, fish, firewood, pottery, small cattle, and milk. Don't let anything thereof remain outstanding. [Don't] make me treat any part of their wages as balance due. Be to it and pay heed!"

More than at any other site in Egypt, in the workers' village I feel the presence of people with whom we share familiar emotions and concerns. Listen to two ancient voices—the scribe Pabaki addressing his father, the draftsman Maani-nakhtef:

"I have heeded what you told me, 'Let Ib work with you.' Now look, he spends all day bringing the jug of water, there being no other task charged to him, each and every day. He hasn't heeded your admonition to ask of him, 'What have you accomplished today?' See, the sun has set, and he is still far off [with] the jug."

Workmen left the village early each morning

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2080 B.C.

1760 B.C.

1539 B.C.

A GRAVEYARD FOR ETERNITY

Pyramids were the tombs of choice for pharaohs of Egypt's Old Kingdom, whose political world was centered on Giza and the Nile Delta region. So too was their gateway to the netherworld. But pharaohs of the early New Kingdom traced their dynastic roots farther south to Thebes (present-day Luxor) and wanted their tombs built closer to home.

Between 1539 and 1078 B.C., practically all pharaohs were buried in the Valley of the Kings.

Because its primary peak, called el-Qurn, resembled a pyramid, the new necropolis resonated with a powerful symbolic charge. The site also seemed more secure. Sentries stationed at the valley's only entrance could discourage tomb robbers. Or so the kings hoped.

Nonetheless, most tombs had been ransacked by the time archaeologists began excavating in the early 1800s. Since then 62 tombs, many of them royal, have been discovered here, each one assigned a KV, or Kings'

Valley, number, usually in the sequence in which it was found.

In ancient days the memory of dead kings was kept alive by funerary cults. Devotees celebrated not at the tombs, however, but at royal temples built on the plain between the valley and the Nile River. Together the tombs and temples formed a City of the Dead, or what one Egyptologist called "the royal funerary machine."

NEW KI

18TH DY Ahmosis Amenoph Thutmosi

Thutmosi
Hatsheps
Thutmosi
Amenoph
Thutmosi
Amenoph
Akhenate
Smenkhk
Tutankha
Ay
Horemhel

19TH DYI Ramses I Seti I Ramses II Mernepta Seti II Amenmes Siptah Tawosret

20TH DYI Sethnakh Ramses II Ramses V Ramses V Ramses V Ramses V Ramses V Ramses IX

Based on r Egyptian N

Ramses X



KV 11

K١

18th Dynasty

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Greco-Roman age

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30 B.C.

KV 2

NEW KINGDOM PHARAOHS

142		
18TH DYNAS Ahmosis Amenophis I Thutmosis I	1539-1514 1514-1493 1493-1483	KV 397 KV 20 KV 38
Thutmosis II Hatshepsut Thutmosis III Amenophis II Thutmosis IV Amenophis III Akhenaten Smenkhkare Tutankhamun	1483-1479 1479-1458 1479-1426 1426-1400 1400-1390 1390-1353 1353-1336 1334-1333 1333-1323 1323-1319	KV 20 KV 34 KV 35 KV 43 KV 557
Horemheb	1319-1292	KV 57

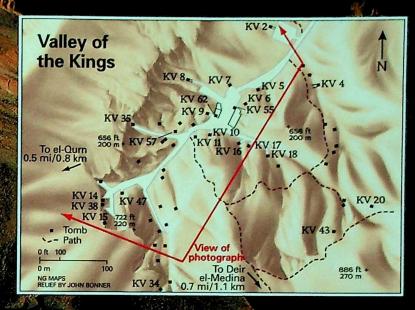
19TH DYNASTY

1911 DIIVAS		
Ramses I	1292-1290	KV 16
Seti I	1290-1279	KV 17
Ramses II	1279-1213	KV 7
Merneptah	1213-1204	KV 8
Seti II	1204-1198	KV 15
Amenmesse	1203-1200	KV 10
Siptah	1198-1193	KV 47
	1193-1190	KV 14

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1190-1187	KV 14
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1150-1145	KV 9
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1106-1078	KV 4
	1190-1187 1187-1156 1156-1150 1150-1145 1145-1137 1137-1129 1129-1128 1128-1110 1110-1106

Based on research by Rolf Krauss, Egyptian Museum, Berlin



So many tombs, temples, shrines, and other ruins blanket
Thebes that Egyptologists have been kept busy here for nearly two centuries. "It is," says the author, "the richest archaeological site on Earth."

KV 7

KV 6



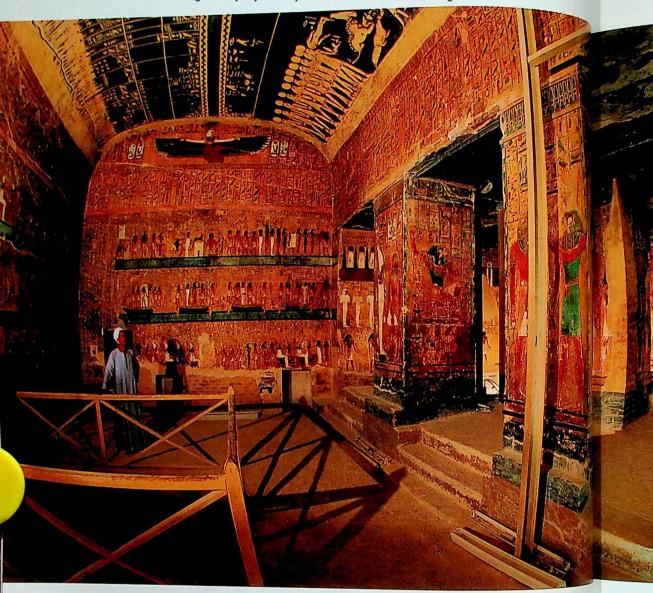
KV 8

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and spent an hour climbing over the hill to the Valley of the Kings. At the end of the day they returned along the same path—unless they chose to spend the night in one of the stonewalled rest houses on the hilltop.

T TAKES ME less than half an hour to hike from Deir el-Medina to the hilltop. A cool breeze—the "sweet breath of the north wind" to the ancient Egyptians—nearly always blows, making hot summer days bearable.

Seated on a rock outcropping with my back to the Valley of the Kings, I peer down on a series of stony hills pockmarked with the entrances to hundreds, perhaps thousands of private tombs from the New Kingdom; most have been plundered but not excavated. Half a mile farther east stand the royal temples of nearly two dozen pharaohs, with great stone columns and pylons and thick brick walls jutting from the desert sand.

Between the desert and the Nile a doze mud-brick villages still hum with the agele rhythms of daily life. Children swat sheep and goats down narrow paths, stirring up dust the makes them appear to walk on clouds. Your boys sit astride water buffalo submerged their necks in the muddy water of an irrigation canal. The panorama reminds me of scene painted on the walls of the ancient tombs.

At 8 a.m. the temperature on my hilltop halready climbed to 95°F. The sky is cloudled The modern town of Luxor lies four miles and on the east bank; I can make out the tops of the temple pylons at Karnak and Luxor through the palm trees. Several tourist boats on the Nijockey for moorage.

Nothing disturbs the tomblike silence

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Sacred stories unfold across 16 chambers and corridors in the tomb of Seti I, father of Ramses II. "For the Egyptians, the plan of a tomb was like a road map from this world to the next," says the author. "The tomb's decorations were like a guidebook." Few people, though, were meant to see this guide to the afterlife. Built neither as a public memorial nor to impress posterity, the tomb served as an instrument, the means to a new beginning.

here, except for the whisper of the breeze, the occasional barking of a dog, and the crying of a child in a distant village.

seems little different from hundreds of other valleys at the desert's edge. Shaped like a human hand with fingers splayed, the Valley of the Kings covers only about seven acres—smaller than nearby valleys. Towering over it is el-Qurn, a 1,500-foot peak shaped like a pyramid. Some Egyptologists believe that this natural symbol of the sun god Re led to the selection of the Valley of the Kings as the site of royal tombs. Another reason was security: There's only one parrow reason has been seen at the control of the value of the same of the value of the reason was security: There's

only one narrow gorge leading into the valley.

By the time Roman travelers hiked the rocky trail and scratched their names on tomb walls,

ancient robbers had despoiled most of the royal mummies and carted away the treasures buried with them so that the deceased could live as they had on Earth—furniture, papyrus scrolls, amulets, jewelry, ritual objects, statues. Napoleon Bonaparte brought a team of scholars to record Egyptian antiquities when his army invaded in 1798, and adventurers and archaeologists in the 19th and 20th centuries entered tomb after tomb.

One of the largest and best decorated tombs is that of Seti I, the father of Ramses II. Seti, who did much to promote prosperity during his 11-year rule, overran Palestine, made peace with the Hittites in Syria, opened mines and quarries, and enlarged the great Temple of Amun-Re at Karnak. The discovery of his tomb by Giovanni Battista Belzoni in 1817 caused as much furor in the European press as that of Tutankhamun's tomb 105 years later.

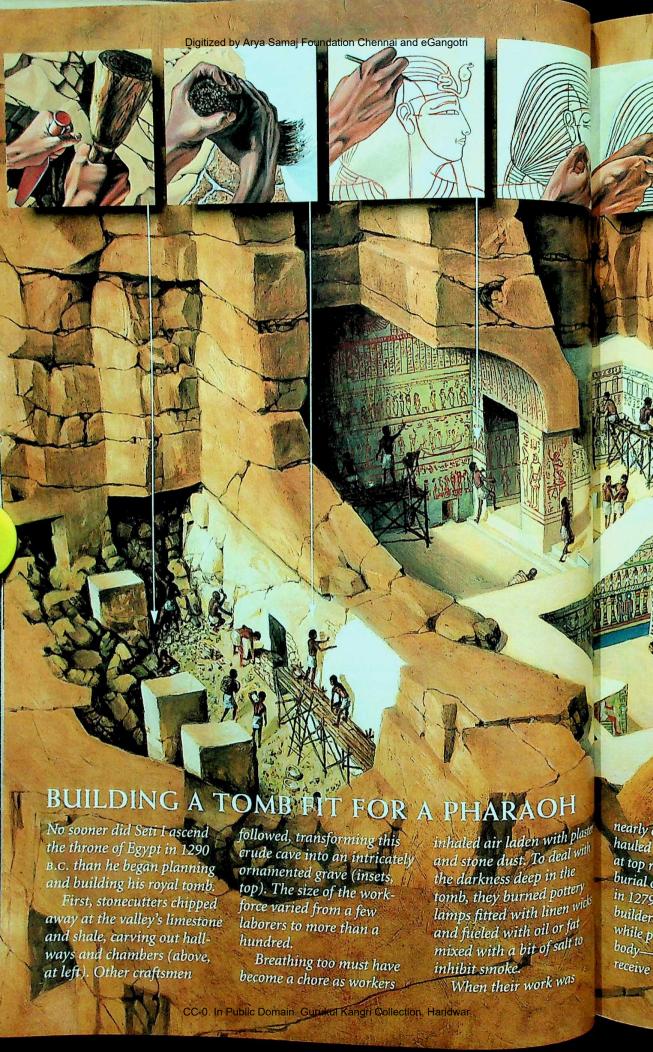
Italian by birth and a hydraulic engineer by training, the flamboyant Belzoni had toured Europe in a vaudeville show in which he carried a dozen men perched on an iron frame braced on his shoulders. In 1815 he sailed to Egypt and over the next two years uncovered four royal tombs. Seti's was the most famous.

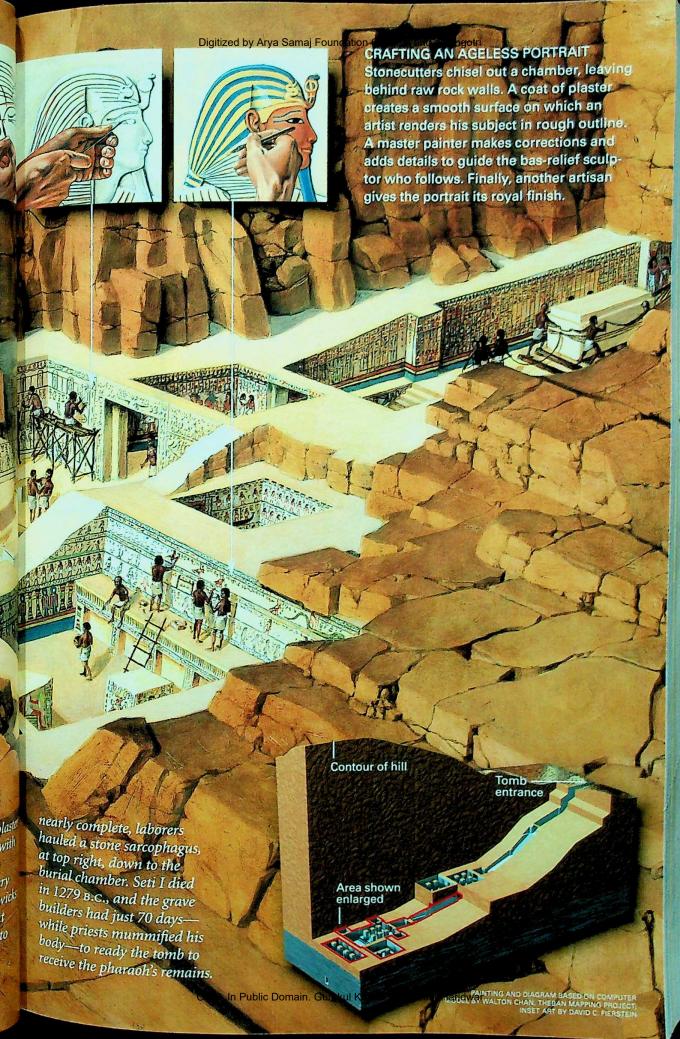
Painted reliefs, drawings, and hieroglyphs covered almost every wall, pillar, and ceiling. In the burial chamber Belzoni gazed up at a dark blue vaulted ceiling that glistened as if painted the day before. Red stars overlay figures representing the constellations as the ancient Egyptians saw them—Ursa Major as an ox, Cygnus as a man with arms outstretched, and Orion as a running man.

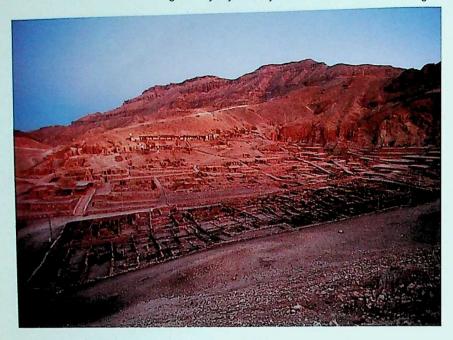
As Belzoni's flickering candle shone on Seti's sarcophagus, its translucent alabaster glowed in the gloom. Nothing like it had been seen before, but gone were the mummy and almost everything else that was movable.

The mystery of Seti's missing mummy was solved in 1881, when the notorious Abd el-Rassul family confessed to plundering a tomb they had discovered hidden behind a nearly inaccessible crevice. Ancient priests, fearing grave robbers, had stashed Seti's remains and 40 other mummies there.

Seti's mummy now rests in the Egyptian Museum in Cairo. X-rays show that before death the pharaoh lost a tooth. After death the head and neck were broken from the body and the abdomen was crushed, perhaps by







the priests who transported the mummy to its secret grave.

Seti I died in June 1279 B.C., and Ramses II took charge of his father's funeral. After the priests wrapped the mummy and placed it inside several nesting coffins, a flotilla bearing priests and officials, ceremonial vestments, incense, and funerary furniture set off up the Nile from the delta toward Thebes. Peasants lined the riverbanks. Some cheered their new pharaoh; others stood in silent prayer, mourning the old.

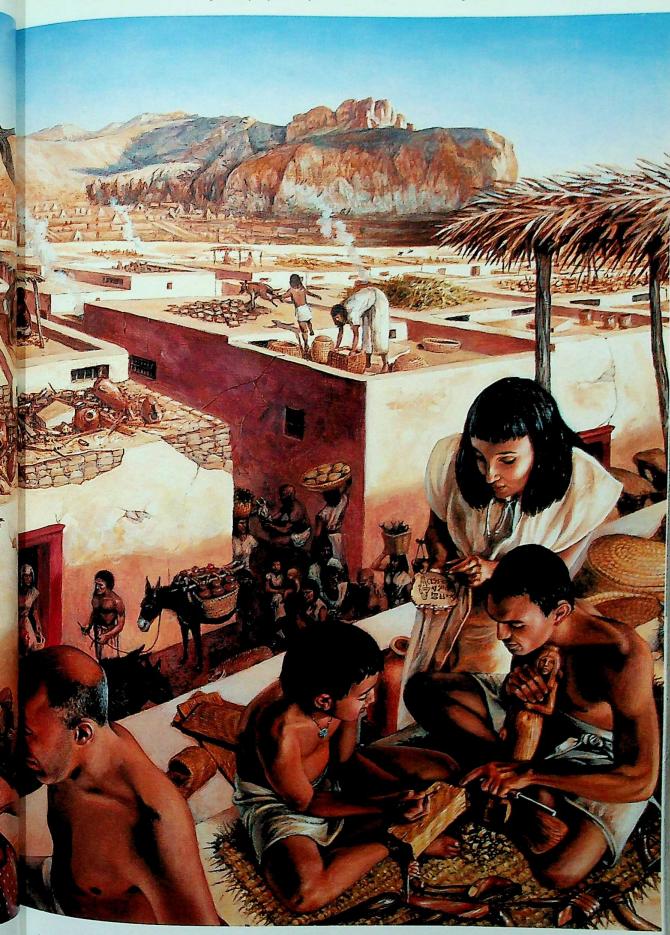
When the flotilla reached Thebes, probably in August, priests received the mummy and performed ceremonies in the major temples. I can imagine the great procession leaving the Temple of Amun-Re at Karnak, crossing the Nile, and sailing along a canal that cut westward through farmland toward Seti's royal temple. There the procession stopped while the priests performed ritual ceremonies so the mummy could thrive in the afterlife.

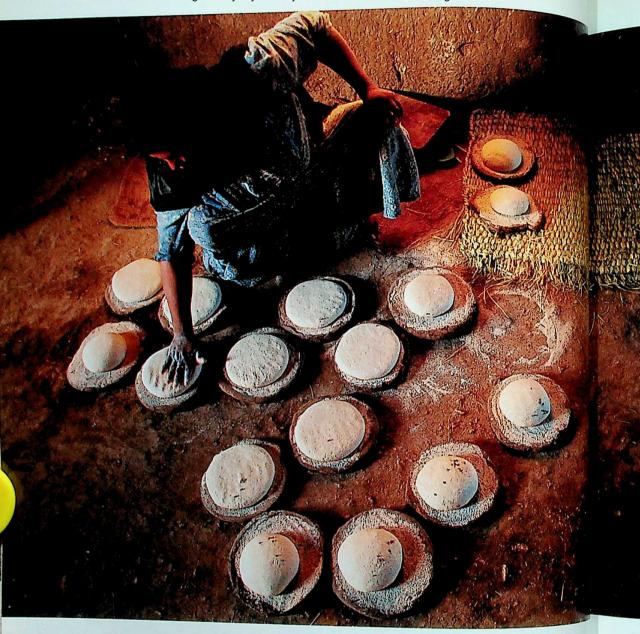
Proceeding on foot, the cortege climbed through the barren hills to the Valley of the Kings and Seti's tomb. The mummy was laid to rest in the burial chamber, along with everything needed for the journey into the afterlife: the Book of the Dead, containing spells to protect the deceased; mummy-like statuettes called ushabti to act as servants; offerings of food and wine; and jewelry and furniture to make the afterlife more comfortable. Not until Ramses II died 66 years later would this ceremony be performed for another pharaoh.

ARTISANS OF THE AFTERLIFE

The village of Deir el-Medina, which has undergone extensive excavation (above), was home to the craftsmen who built the royal tombs. The men worked an eightday week, then spent a two-day weekend at home with their wives and families (right). Some used their off hours to freelancecarving or painting furniture and ritual objects, lower left, for private clients. Fathers taught their crafts to their sons, lower right. Others prepared for the week ahead by bartering portions of their salary—fish, vegetables, oil, and grain—for other household supplies.







n 1995, six seasons after we began work in KV 5, a European television reporter visited us. When she asked what we were digging at the moment, I described our work in the 3,600-square-foot pillared hall.

"This is one of the largest pillared halls ever found in an Egyptian tomb," I said.

"Did you also find colored balls?"

I did a double take. "I'm sorry?"

"I mean, were billiard halls common in ancient Egypt?"

I had trouble keeping a straight face as the camera rolled. When the interview was done, I suggested we tape it again, but she declined.

After clearing the doorway in the rear wall of the pillared hall, we began digging in the chamber beyond, which we assumed would be small. When I struggled through the narro crawl space into the chamber, Muhamma Mahmoud was there with Marjorie Aronol a University of Michigan Egyptology studen

"Look," Muhammad said, pointing to again in the wall of debris that lay ahead.

I shone my flashlight into the gap; there nothing but blackness. Strange, I thought light should reflect off a wall. Crawling for ward, we found that the corridor, which about nine feet wide, continued a hundred into the hillside. There was one door on left, another on the right, then two more, the four. We counted doors as we crawled forward 10, 12, 16, 18. Other tomb corridors in Valley of the Kings have at most one of the doorways cut into their walls. I had never see

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The business of death has always leavened life around the valley. These days, archaeological excavations employ teams of laborers, many of whom live near the necropolis in villages like Qurna, where bread takes shape the old-fashioned way (left). Contemporary understanding of life here 3,200 years ago comes partly from a mother lode of artifacts called ostraca (right), shards of limestone used to record all

sorts of daily details, such as wages for tomb workers. Many craftsmen and their families were buried in tombs of their own, reflecting the relative affluence of this working class. Images in their tombs (below) depict a bucolic netherworld devoid of the cosmic responsibilities eternally shouldered by the pharaohs.



a corridor like this one in any Egyptian tomb. Muhammad pointed his flashlight down the corridor. "What's that?" he asked suddenly.

"Oh, my God!" Marjorie gasped. As we turned our flashlights that way, a human form took shape. Muhammad began whispering a prayer from the Koran.

The figure stood ghostlike in a niche at the end of the corridor. As we inched closer, the form became clearer: It was a five-foot carving coated with plaster painted gray-green. Even though the face was missing, we recognized it as the quintessential god of the afterlife, Osiris, who is often shown as a mummiform figure with his arms crossed over his chest. Each hand held a shepherd's crook and a flail.

We sat for several minutes at Osiris' feet,

slowly moving the flashlight beam over the figure from head to toe, again and again. It was a strange feeling, sitting 200 feet underground in utter silence, our light focused on an image of the god of the afterlife. For an instant it was 1275 B.C. again, and this was ancient Thebes. I could imagine priests chanting prayers and shaking tambourines. I could feel the floor tremble as great sarcophagi were dragged down the corridor. I could smell incense and feel priestly robes brush my arm as the funeral procession moved slowly past.

Finally I aimed my beam at the doorways to the left and right of the statue. More surprises. These doors didn't lead to small side chambers, as the other doorways in the corridor did, but into yet other corridors that extended even



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legendary trove of funerary goods, including several royal chariots. If a young king who ruled only briefly was buried with such treasures, what then might the tombs of the great pharaohs have contained before grave robbers pharaer them?



deeper into the bedrock. And there were yet more doorways cut into *their* walls.

"I can't believe it," Marjorie kept repeating. Suddenly KV 5 had gone from a small, unimportant tomb to . . . to what? We crawled back down the corridor, re-counting the doors.

"There have to be over 65 chambers in the tomb," I said—underestimating, as we later discovered. No tomb in the Valley of the Kings has more than 30 chambers; most have only six or eight. Many tombs plunge straight into the steep hillsides, but KV 5 resembles an octopus surrounded by its tentacles.

And there was something else: Inscriptions in Chambers 1 and 2 indicated that KV 5 was the burial place of several sons of Ramses II. Ramses "Junior," the second son, bore titles similar to those of his elder brother, Amonherkhopshef: "Fan-bearer on the King's Right Hand, Heir, Prince, Royal Scribe, General, King's Eldest Son, First King's Son and First of His Majesty, Beloved of Him, Ramses." Of the 30-plus sons, we knew that Merneptah was buried in his own tomb in the Valley of the Kings; two others may also have had separate tombs. Could the rest be here in KV 5? Could the corridors to the left and right of the Osiris figure slope downward to a lower level of rooms? Or might other corridors descend to a cluster of burial chambers? It will probably be many more years before we find out.

Marjorie, Muhammad, and I were the first people in millennia to see these corridors, to touch these carvings, to breathe this stale air. What a humbling experience to sit when Ramses II had come on sad occasions to bur his sons. None of us said a word.

Twenty minutes later we crawled out of the tomb, sweating and filthy and smiling. As the magnitude of our discovery began to sink in thought to myself: "I know how we're going to be spending the next 20 years."

and his favorite wife, Nefertan Ramses II ruled for an impression 66 years. During his long reign Ramses expanded and secured Egypt's border and built grandiose temples and colossistatues of himself and Nefertari up and down the Nile Valley.

Ramses II was tall for an ancient Egyptian five foot eight, until arthritis forced him to stoop. Slight but well muscled, he had a narrochin, high cheekbones, an aquiline profile, and large ears. His teeth were so severely worn that the pulp cavities and nerves were exposed; by gums were badly abscessed. His red hair muschave set him apart from the typically dark haired population of Egypt and western Asiang

Ramses II died in August 1213 B.C., who he was about 90 years old. His tomb, while lies less than 200 feet from KV 5, remains of the great unknowns in the Valley of Kings. Though the entrance corridor has becaccessible since antiquity, thick layers of flow debris still fill most of the tomb, so our known edge of its art and architecture is sketch

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Mummification preserved not only a king's skin and bones but his internal organs too, ensuring that the pharaoh's spirit had a body in which to dwell when he revisited his earthly realm. The lungs, stomach, liver, and intestines of King Tut, for instance, were treated with a preservative and stored in a four-chambered alabaster chest sealed with head-shaped stoppers (left). Tut's viscera were entombed inside a gilded wooden shrine protected by a quartet of goddesses, including Selket (right).

When our Theban Mapping Project worked there, the debris was so deep we were often unsure whether we were walking down sloping corridors or silt-covered stairways.

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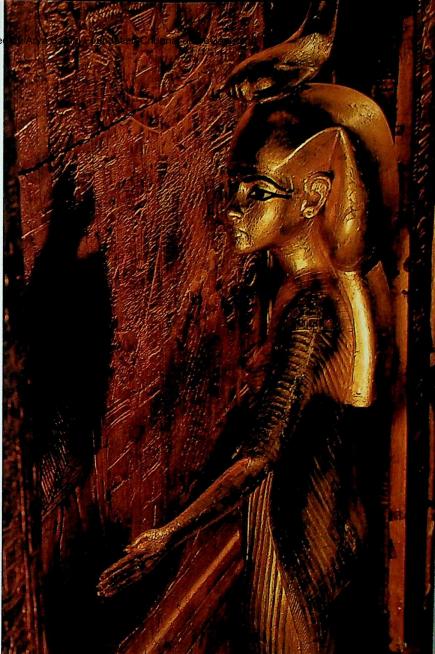
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By contrast, the tomb of Ramses' beloved Nefertari is well known. It is the largest and loveliest in the nearby Valley of the Queens. We know little about Nefertari herself, for custom seems to have dictated that the biographical details of royal wives go unrecorded. Perhaps the daughter of a Theban

nobleman, Nefertari was one of the first women wed to Ramses II. Paintings depict her as beautiful. Her skin is rosy, unlike the pale yellow that characterizes females in most Egyptian paintings. Her high status as principal wife earned her an honor enjoyed by only a few Egyptian women before her: She was deified in her lifetime.

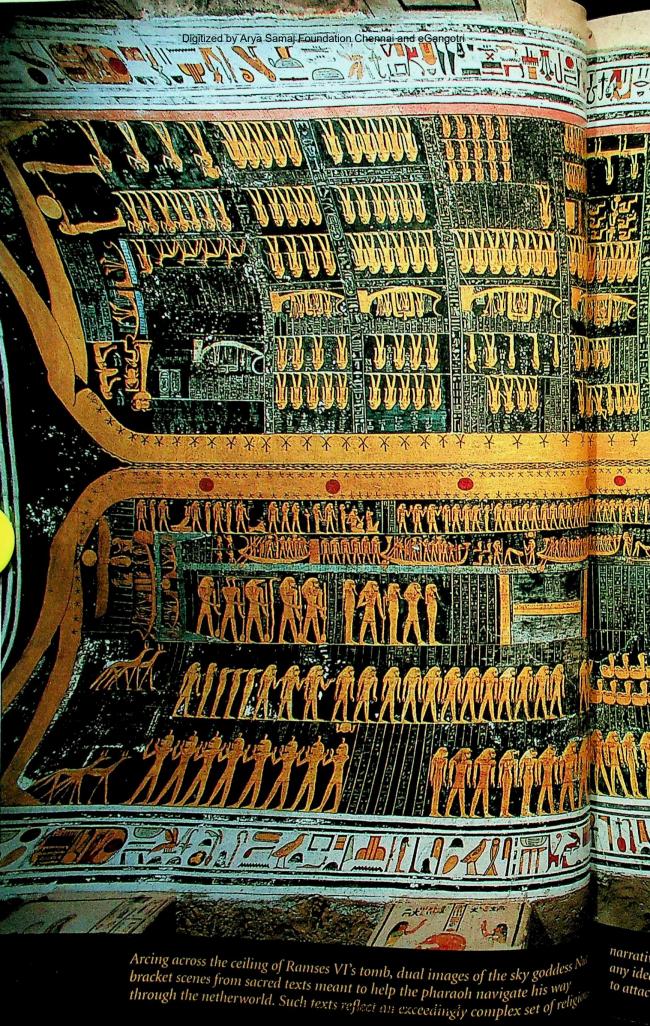
AMSES TOO WAS WORSHIPED as a deity in his own time. Since he was a living god, his sons attended to many of his secular duties—settling legal disputes, conducting foreign relations, and overseeing Egypt's agriculture, irrigation, and economy. This may explain why a tomb as unusual as KV 5 came into existence. His sons

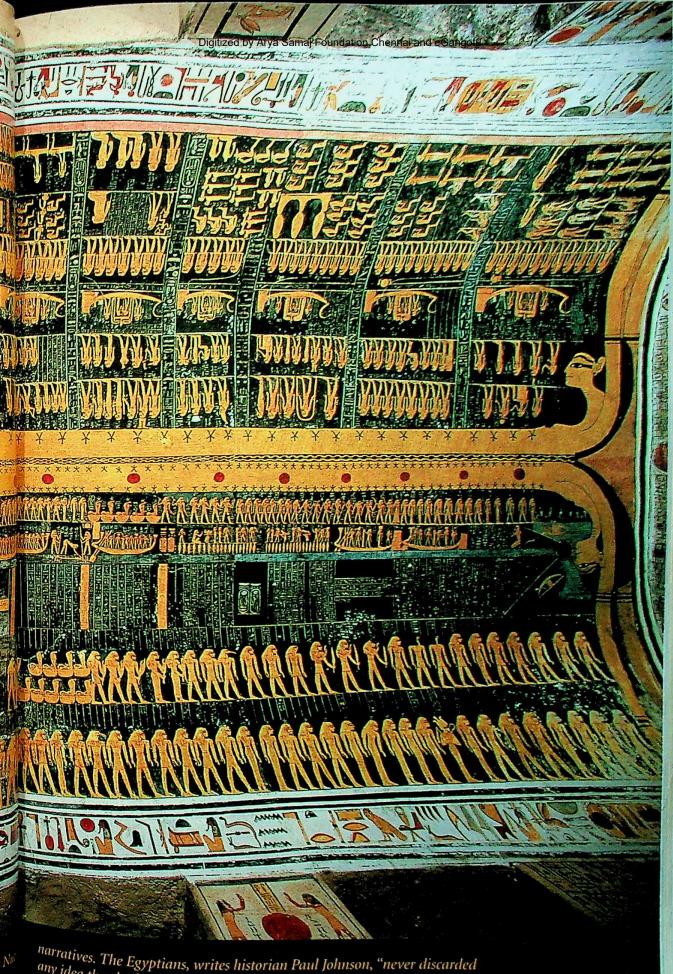


held positions of greater responsibility than crown princes had in the past, so when they died before he did, each was given a tomb more elaborate than that of an ordinary prince. Each may have had not only a burial chamber but also several beautifully decorated rooms filled with offerings and funerary goods.

This past year we unearthed an adult male skeleton from a pit in Chamber 2. A son of Ramses II? Our workmen talked excitedly about that possibility. I warned them that the bones might have come from a later burial or been washed into KV 5 by flash floods, but nothing diminished their enthusiasm.

"You know," one workman said, "Egyptian mummies are stuffed with gold. Even if we can see only bones now, there will be gold too."





narratives. The Egyptians, writes historian Paul Johnson, "never discarded any idea they had conceived, preferring, whatever the cost in logic or consistency, to attach to it . . . any additional ideas or explanations as they occurred."

"I will be on television," another said. "My mother will be so proud."

Toward the center of the pit we uncovered the mummified leg of a young cow lying on top of more traces of human bone. This must have been one of the food offerings brought to the tomb to sustain the deceased in the afterlife. Another day we found three human skulls.

Excavating the skeleton proved extremely difficult: The bones were soft, and the fragments were embedded in a cement-like matrix of mud and limestone chips. We had to work with dental picks and artist's brushes to loosen the debris and gently brush it away. Some bones were in such bad shape that we had to apply a thin solution of adhesive every few minutes to keep them from disintegrating.

I squatted in a space only 30 inches wide, braced against the wall with one hand to keep from falling over while I cleaned the skeleton with the other. It often took 10 or 15 minutes to clean and stabilize a single square inch. Every half hour one of the workmen had to help me out of the pit so I could hobble about and restore my blocked circulation.

ow did the human bones and skulls get tossed into the pit? I have a theory. Let's imagine that ancient thieves entered KV 5 and stole objects from Chamber 2. Most likely a human mummy had been buried there in a wooden coffin. The pit is too narrow for a stone sarcophagus, and we've found traces of wood. Hastily they hacked through the coffin and the mummy's wrappings, searching for gold, jewelry, and amulets.

Later robbers removed whatever treasures still lay deep inside the tomb. Somewhere they discovered at least three more mummies and dragged them into Chambers 1 and 2, where light streaming through the front door made it easier to see as they hacked heads from torsos, tossed the skulls into the pit, tore away bandages to rip out the amulets placed across the torsos, and then left the remains scattered over the floor.

To find out if the skulls and skeleton belong to Ramses' sons, we'll need to run DNA analyses. X-rays and other tests will tell us their age at death, cause of death, ailments, and injuries—the parts of life no hieroglyphic texts ever discuss. The main problem will be finding Eroding for thousands of years, the Colossi of Memnon-made in the image of Amenophis III—have fared better than the beliefs that helped shape them. Imagine the impact on Egypt's faithful when foreigners and their alien deities conquered the land of the pharaohs, whose power emanated from the gods. Such defeats must have dealt concussive blows to the Egyptians' worldview and to their belief in the inviolate link between this world and the world to come.



tissue samples to compare with our materi. The chances of getting uncontaminated samples from the mummy of Ramses II are almonil. None were taken before the mummy with shipped to Paris in 1976, where it was treat with radiation and chemicals to protect it for bacteriological damage.

One solution would be to compare the DN results from each of the four skulls. If close related, then almost certainly they are Ramsons. Another possibility would be to analytissue from the mummy of Merneptah, one Ramses' sons and his successor.

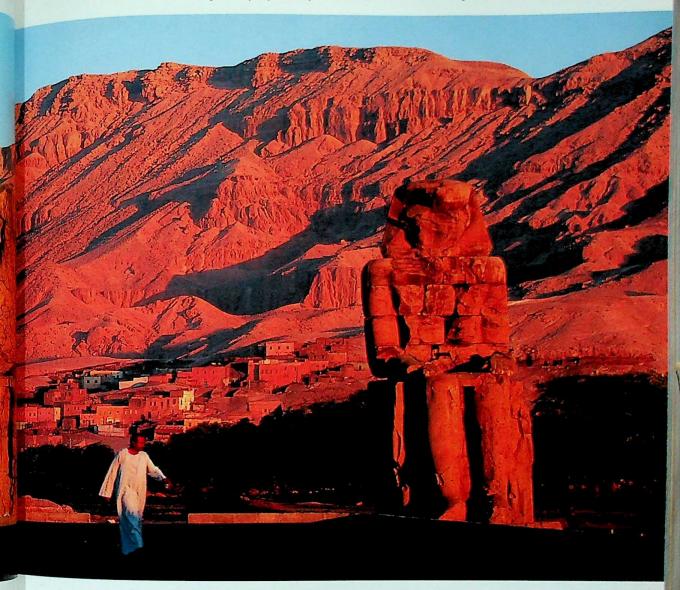
Just before shutting down for the season we removed the three skulls from the pit left the skeleton in place. At some point we have him x-rayed, but for now, as Ahmanmoud Hassan, our excavation foremaid, "We can let him sleep."

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E HAVE COLLECTED so much material from KV 5 that it will take us years to analyze it all. There are fragments of plaster reliefs to compare with decorations in other tombs, pottery to reconstruct and date, and bones to identify and test. As a general rule, one day's work in the field generates three or four days' work in the laboratory, library, computer room, and office.

At the end of the 1997-98 field season, my wife, Susan, and I sat on the Amoun Hotel balcony, watching the sunbirds take a final flight before settling in for the night. It was our last evening in Thebes, and as the sun set, one of our workmen called from the courtyard below.

"Doctor. Hello, doctor," Nubie said. "Can I come up, doctor? I have some news."

"Of course, Nubie," I called back.

Nubie climbed the stairs to our balcony. "My wife had our new baby last night." He looked at Susan. "We named her Jasmine, but whenever you are here, we will call her Susan in your honor."

Ahmed Hassan and several of the hotel staff heard our laughter and came up to offer their congratulations.

Ahmed turned to me. "It is good, isn't it, doctor? There are problems, but then we remember that we have family and friends, and sometimes God blesses us even more with babies. And our work is going well, and when you return I am sure we will find many wonderful things in KV 5." He paused, then looked at me and smiled. "God is great! Life is very nice here in our village, doctor. Don't you think so?"

For more Egyptian mysteries join our online forum at www.nationalgeographic.com/media/ngm/9809/.

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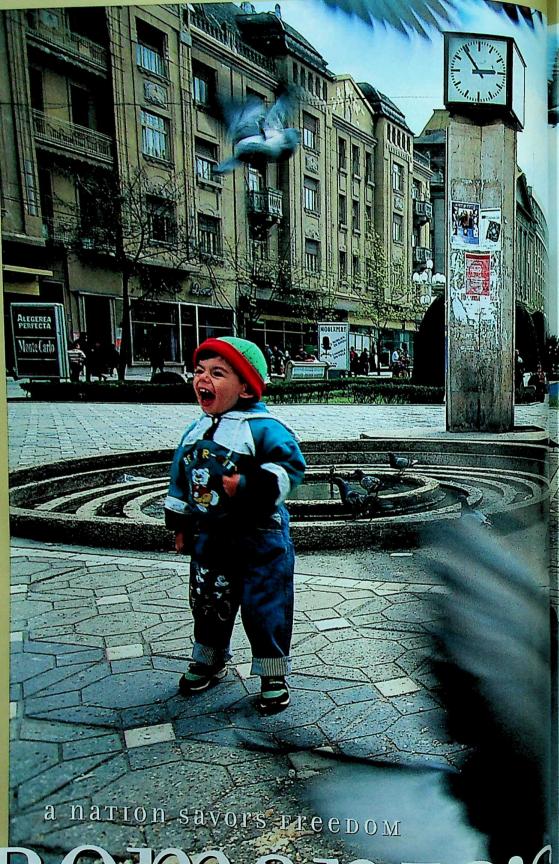
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Buoyant spirits here the min of Operauskul Kangri Collection, Haridwar Timişoara, where in 1989 demonstrate in Timişoara, where in 1989 demonstrates

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ignited a revolution ending Romania's dark decades of communist dictatorship.



CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar

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Grins are contagious as Gypsies congregate in western Walachia for a three-day festival honoring St. Gregory. Old gold coins—once subject to confiscation—are now flaunted as jewelry. The country's Gypsy, or Roma, population is Europe's largest. Kept as slaves until 1864, the Roma still suffer persecution, stereotyped as itinerant thieves.

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Star-spangled shirt and a Bucharest bus ad reflect the Americanization of Romania's capital, where National Basketball Association games are telecast live. The country turned from a command economy toward Western-style capitalism after the '89 revolution, which climaxed with the Christmas Day execution of 24-year leader Nicolae Ceausescu and his wife, Elena. CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar

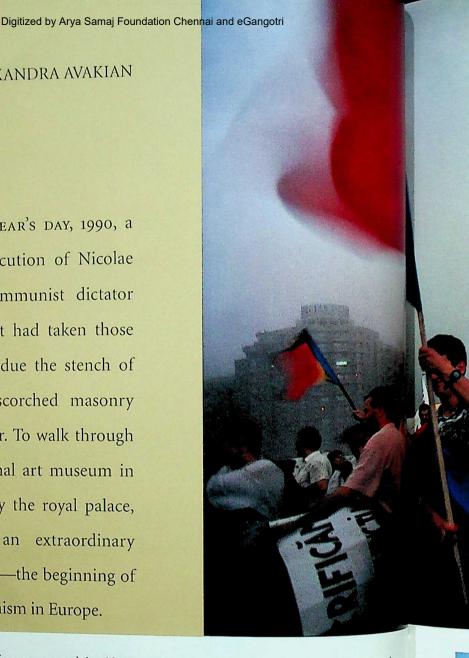
By ED VULLIAMY Photographs by ALEXANDRA AVAKIAN

T WAS NEW YEAR'S DAY, 1990, a week after the execution of Nicolae Ceauşescu, the communist dictator of Romania, and it had taken those snowy days to subdue the stench of gun smoke and scorched masonry that hung in the air. To walk through the battered national art museum in Bucharest, formerly the royal palace, was to witness an extraordinary moment in history—the beginning of the end of communism in Europe.

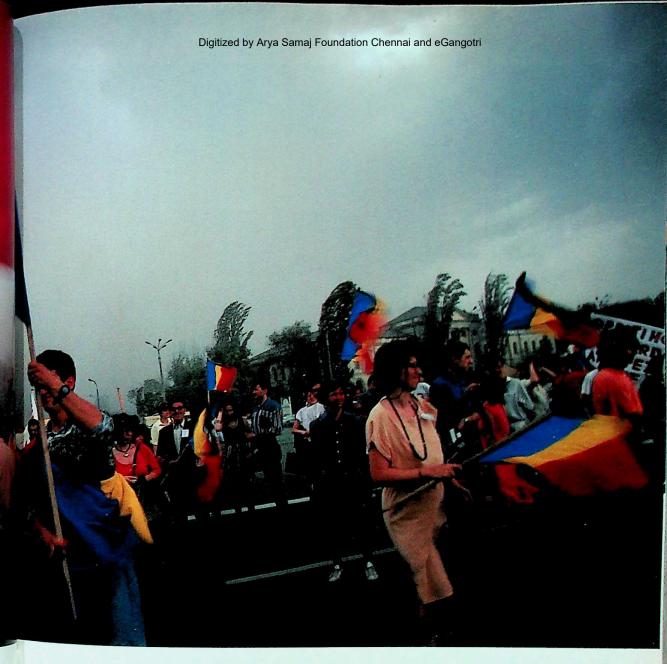
A scene of destruction presented itself on the cobbled square below: flower-strewn tanks grinding over charred debris, nervous soldiers and crowds come to gawk, celebrate, or mourn their dead at makeshift shrines.

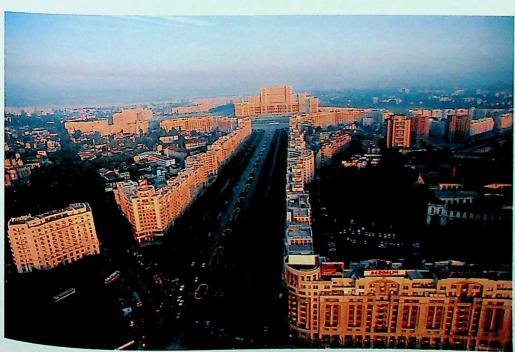
Codruţa Cruceanu, 33, the museum's curator of European painting and sculpture and an expert on Flemish painting, walked with me through one of the galleries. Canvases were laid out around us like corpses. "The secret police

ED VULLIAMY, a correspondent for the Guardian, won numerous British press awards for his coverage of the wars in the former Yugoslavia. He is the author of Seasons in Hell, Understanding Bosnia's War. Manhattan-born photographer Alexandra Avakian is recognized for her documentation of social and political change, from the breakup of the Soviet Union to life in Haiti. Her article on the Gaza Strip appeared in the September 1996 Geographic.



Embers of the old order glow in Bucharest as trade unionists demand government protection from unrestrained free enterprise. Emblem of the old order survives in the hulking House of the People, now called the Palace of Parliament (right, at top). One of the world's largest buildings at three and a half million square feet, it is widely despised as a monument to Ceauşescu's megalomania. Apartments built for the communist elite now bear billboard ads.



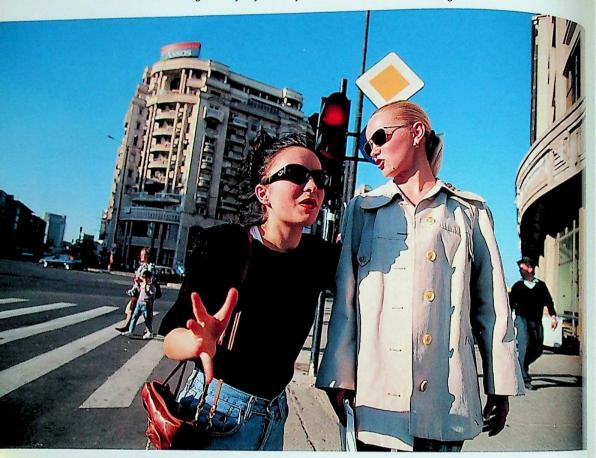


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Sleek and chic, sisters Mariana and Ramona Sabau personify the increasingly elegant look.

Bucharest's young people. Women had mostly done without Western fashions and cosmetics of Ceauşescu restricted their import; few dared risk arrest by buying on the black marks.

came in through the Italian Renaissance," Codruţa said, describing her curious experience of the revolution. "Our army entered through the medieval Romanian collection. You can see the damage done here in the 19th-century national school."

Back then, covering events in Romania for my newspaper in Britain, I watched the battle between insurgent Romanian army units and the remnants of Ceauşescu's secret police rage around the museum for three days. Fires threatened to spread throughout the building. Codruţa's colleagues did what they could to rescue the paintings. Some were saved, others ripped to shreds.

We strolled on, stepping through the incinerated remains of museum catalogs lying across the parquet like autumn leaves. At the end of the gallery was a piano, intact but covered with dust. Codruţa lifted the lid and played a few notes. "It still works," she said with a lambent smile. "So you see, there is hope."

Romania was the first Eastern Europe country to mount a successful armed insured tion against communist tyranny, if not actual the first to shed communism. But in the year since Ceauşescu's fall, hope has sometime worn thin: The corrupt power of his elite was one entrenched that real change has come pair fully slowly.

Impatience led to another power shift 1996, the year I returned to Romania NATIONAL GEOGRAPHIC. Against the predictions of pollsters, Emil Constantinesculuniversity professor with no loyalties to communist regime, was elected preside Inheriting an economy in shreds and one the highest infant-mortality rates in Europe, has had a difficult start. Last year, as the genment continued to remove price control the economy shrank by 6.6 percent and into reached more than 150 percent.

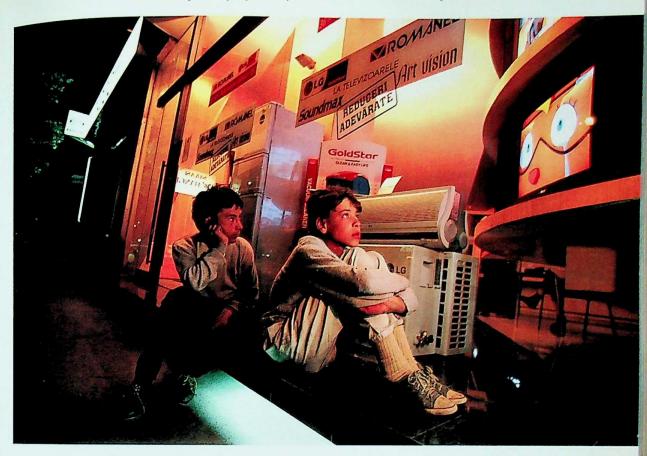
Romania today is an odd juxtaposition antiquity and modernity. The almost media

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ROMANI



Catching amusements however they can, two homeless boys watch cartoons through the window of a Bucharest appliance store. Ceauşescu's policy of encouraging large families through limits on birth control increased Romania's population of abandoned children.

ways of the countryside entwine with the black, heavy industry of the communist era and now the icons of Western capitalism, as the Cold War gives way to a cola war between Coke and Pepsi. Another tension President Constantinescu and his reformers must contend with derives from the people themselves—a mosaic including Romanians, Hungarians, Roma (Gypsies), a few remaining Germans, and fishermen in the Danube Delta who speak Romanian but are ethnic Ukrainians (map, page 45). Judging from other post-communist countries of Eastern Europe, nationalist fervor is a potentially dangerous force.

NE THING the government hopes to increase is the number of tourists on the trail of Dracula, the most famous ethnic Romanian and something of a national hero. Bram Stoker's vampire was a literary enhancement of a real-life prince known to his enemies as Vlad Ţepeş—Vlad the

Impaler. His father was Vlad Dracul (*dracul* means dragon or devil), so he took the name Vlad Dracula, son of Dracul. Among his skewered victims were tens of thousands of invading Turks in the winter of 1461. Dracula was born in the fortified town of Sighişoara, a medieval Germanic city in the region of Transylvania. With its pointed fairy-tale towers, steep streets winding through arches, and stubborn ramparts rising toward a summit, Sighişoara looks the part.

On a pretty square in Sighişoara's old town center, windows are decorated with lace curtains and elegant ironwork, but their panes are vibrating to new sounds along the cobbled alleyways: the thundering of a monotonous song, "Wannabe," by the Spice Girls. It comes from the Boema café, where new red parasols sprout on the terrace and a patron wears a T-shirt with the slogan I Love Free. Something is moving across Dracula country these days, and it has nothing to do with vampires.

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"Coca-Cola Welcomes You to Mediaş" proclaims a huge billboard at the entrance to the town of Mediaş, one of Transylvania's industrial hubs. In the center of town, what was once the Communist Party House of Culture, now the community center, is hopping with adolescents, their white shirts made luminous by ultraviolet lighting, dancing to music you'd hear anywhere else on the planet, which can never be too loud.

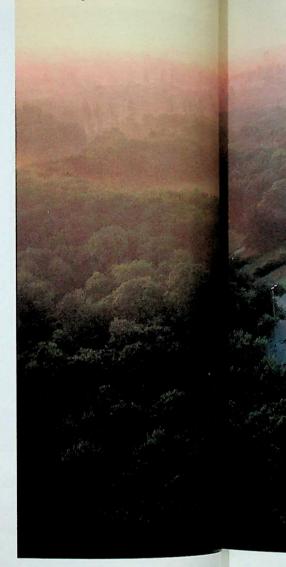
But about 45 miles to the south, in the harsh Lotru Mountains, little has changed since communism, or long before it. This is the season of the exodus of the sheep, streaming across mountain meadows, the valleys ringing with the call of the shepherds. Winter hits suddenly and cruelly in Transylvania, and the sheep are on the move in their hundreds of thousands to quarter in the temperate climes of the Danube Delta. Traffic in villages can be held up for hours by flocks following the road down the valley.

I meet Mircea Costache and old Nicolae Anghel, guiding their flock of 300 sheep up a mountain track for one last night at their summer camp, just as a freezing rain is turning to snow. It feels too cold for September, but the men wear sheepskins over their shoulders and boots wrapped in plastic bags. Mircea, carrying a trusty stick, explains that Dobrin, a scraggy old sheep-turning dog named after a famous Romanian soccer player, is his favorite.

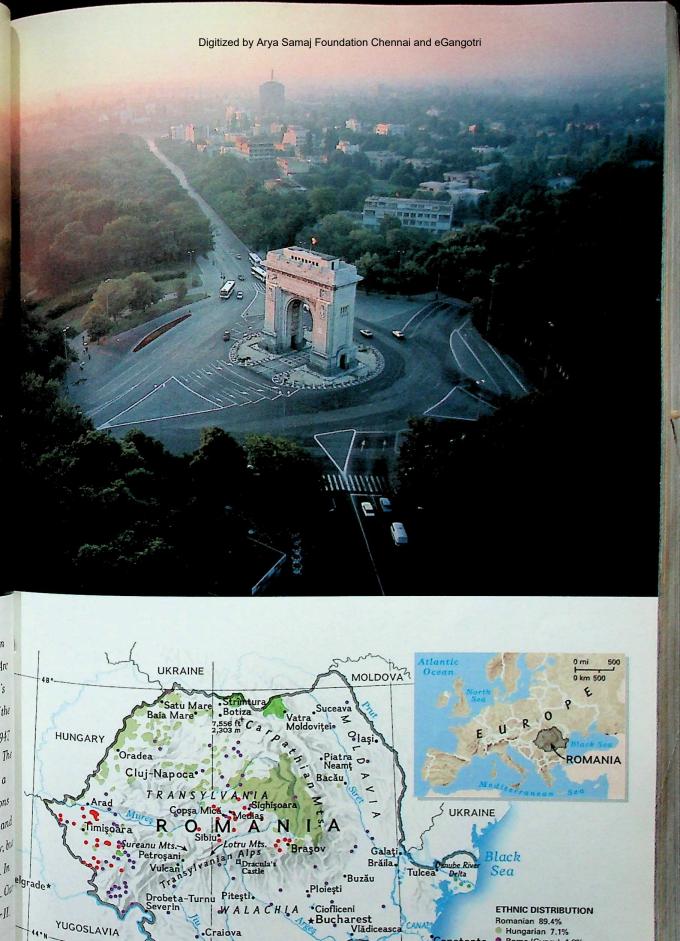
Bears are trouble, Mircea says. "If the bear kills a sheep by the neck, we eat the sheep. But if it takes out the intestines, it's bad luck to eat it. The bear is king of the mountains, but the wolf is their devil. No one knows where he lives, and he is the most intelligent of all of us."

As we enter a thick forest, there is a sudden howl. But this is no wolf, just old Nicolae, the worse for vodka, giving his dog, Ciobanica, a furious hiding. The sheep move through the forest in silence, spectral in the mist. Finally we pass the tree line, out through driving snow onto a barren expanse where the wind bites and the horizon is lost. Mircea's description is apt: "Here we go through the edge and out into the empty."

Despite the vodka Nicolae has not lost his shepherd's sixth sense. Two animals have gone astray. He lets out a terrifying stream of curses: "Du-te dracului!—Go to the devil!" and flings



A touch of France flavors Bucharest in the Arcul de Triumf, inspired by the Arcul de Triumf, inspired by the Arcul de Triomphe. Dedicated to Romania's soldiers, it exemplified this "Paris of the East," a sobriquet less apt after the 1947 communist takeover sapped its élan. The country's name reflects its history as a Roman province; centuries of invasions followed. Principalities of Moldavia and Walachia formed by the 14th century, but Turks held sway into the mid-1800s. In 1918 Transylvania joined the nation. Our rent borders were set after World War II.



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Giurgiu

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Hungarian 7.1%

Ukrainian 0.3%

Other 1.0% 0 mi

Roma (Gypsy) 1.8% German 0.4 %

NATIONAL GEOGRAPHIC MAPS

Constanța

an empty vodka bottle into the mist. "He is telling the God of the sheep's mother to go to hell," explains Mircea calmly. Soon the sheep are retrieved.

Now 28, Mircea lost his job as a tractor mechanic on a state farm after the revolution. To earn enough to care for his mother, he took to the hills to learn the biblical craft. His salary of \$30 a month is low even by Romanian standards—the average wage is \$120—but at least it's steady. "It gets lonely up here," he says, staring down at the lake below us. "I would like to see the many wonders I have never seen"—he mentions America—"but if none of these things happen, then that is what God has decided for me; that is my curse, I accept it and shall stay with the mountains."

At last we reach a small wooden cabin surrounded by squelching mud and manure and a company of pigs and turkeys. Inside, the scene calls to mind one of Codruta Cruceanu's Flemish paintings. Above the fire, whose embers illuminate only a small part of the interior space, blackened buckets hang by hooks and chains from a beam. People are sleeping under mounds of sheepskin blankets. From one of these hunched shapes comes a reedy female voice, issuing an instruction. In response a young woman emerges from the darkness and sits cross-legged by the fire, where she chops a log with a vintage ax. Then she blows the embers to life and stirs the brew in a bucket hanging above the flame. The fire is a blessing, for by now the cold and wet have penetrated skin and flesh, freezing our bones.

The habitation comes slowly to life. The girl is Irina Bara, 16, daughter of the flock's owner, Dumitru Bara. Others in his team of five shepherds emerge through the door from outside. The woman whose command had initiated the evening meal is Maria, Dumitru's wife, who now ladles warm yogurt into metal bowls. Eaten with steaming polenta, it is rich, creamy, and delicious.

In the old days, in theory at least, sheep were as much part of the state-controlled agriculture system as any other animal. But peasants like Dumitru managed to keep a few head of sheep of their own, especially in these wild mountains. Now Dumitru is free to own as many sheep as he wants. In summer they roam state-owned pasture, and in winter he grazes

them on land in the warmer delta for which pays rent—an outgoing he says he can ill afform since the prices for wool are low in comparts with those charged for food and other essetials. "A kilo of wool for a beer," he says, additude that under communism the price of beer so low that a kilo of wool would have bout not only beer but a meal as well. Under communism, a shepherd reminds him, we would have been allowed to have this conversation.

Dumitru nods his agreement, but the lo on his face suggests that he's still as preoccipied with the price index as he is welcomitoward freedom of speech. In the old Romar these mountains were overseen by Ceauşeson, Nicu, who allowed a favored few, induing Dumitru, to trade items such as cheeser wool privately. And so for some people them order has come at a cost.

After supper, hanging onto every calorice heat from the merciful fire and yogurt, I in the shepherds, who must spend the night or side as sentries against marauding wolves. It lay our sheepskins on the frozen ground. "It all die here," Nicolae Anghel grumbles.

ori

Sleep comes, and when first light opensor eyelids, which are covered with snow, the shap herds are already milking the sheep for who Dumitru says will be the last time until not spring. "We start for the plains today," hannounces.

The packing up begins—trucks will arithat afternoon to move the supplies. The she herds, Dumitru, and the sheep will make journey on foot. I set off with them for the mile; then we say our good-byes under a quite ening in the eastern sky as the sun bur through.

ROM THE SHEPHERDS' WATCH, my ward led west to the Sureanu Mountain then south through hamlets of logs and their fires, past hydroelectron dams that rise like cliffs from the rushing was below. No more than a track of jagged root the path then plunges into the valley of the River, Romania's coal-mining heartland.

The revolution of 1989 is only beginning touch what has long been one of the most portant industries, and the blackest of them. The slow pace of political change has help perpetuate an archaic industrial landscape heavy industry, by and large, an old communication.



orphanages: up from squalor

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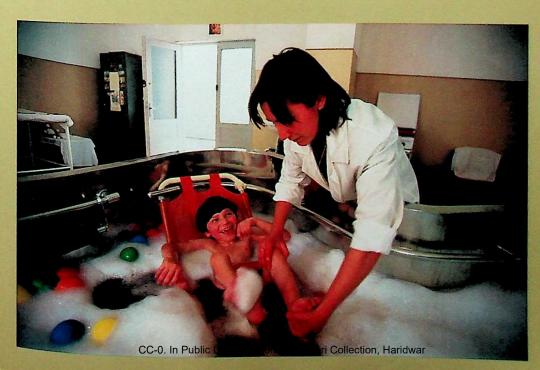
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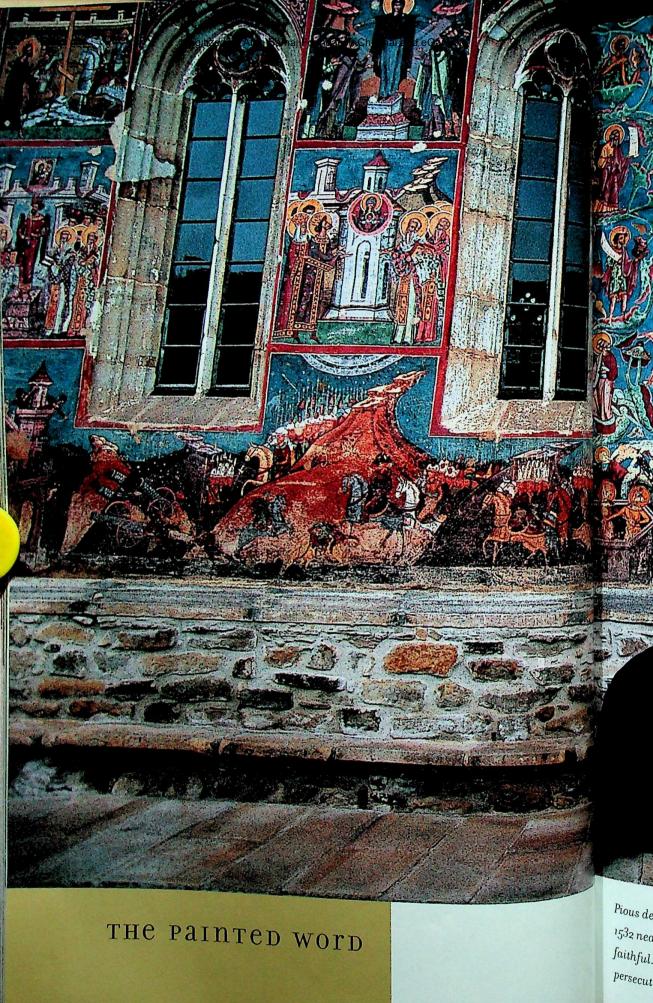
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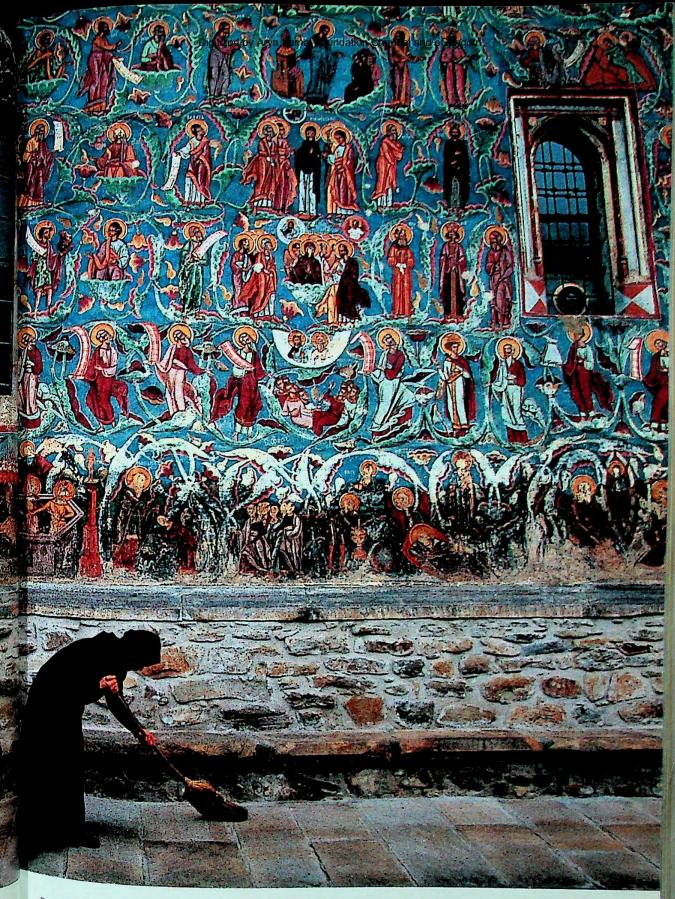
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Hair shaved to combat head lice, children play on the grounds of a Bucharest institute for the handicapped. Indoors, physical therapist Elena Radulescu works the legs of Gabriel Chiran, who is partly paralyzed below the waist. The glare of coverage by a newly unfettered press after the revolution exposed the shame of Romania: neglected children living miserable lives in ill-equipped and filthy orphanages. Donations of money and staff from a host of local and international organizations are helping make improvements.





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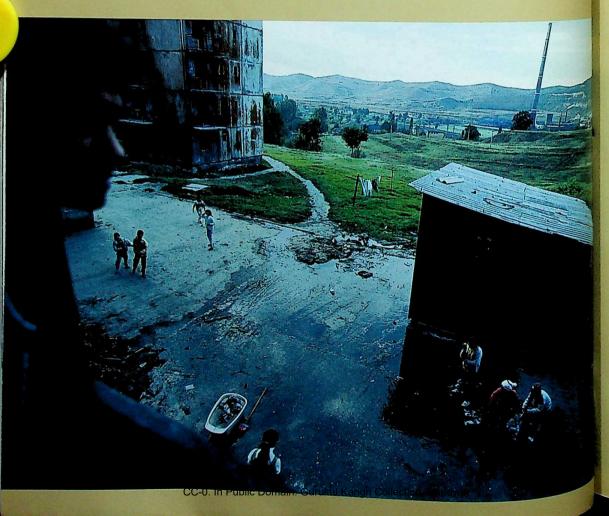
Pious devotion guides a nun at Moldoviţa, a Romanian Orthodox Church convent built in 15³2 near Vatra Moldoviţei. Artwork depicted historical sagas and biblical tales for the illiterate faithful. Though communist authorities did not ban religion, they restricted worship, sometimes persecuting believers. Flagging church attendance rebounded after the regime's collapse.

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Digitized by Arya Samaj Foundation Chennai and eGangotri

LIFTING THE DARKNESS





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Freshly cut peonies, a clean shirt, and a white house signal a partial victory against pollution in the notoriously fouled town of Copşa Mică. A June 1991 NATIONAL GEOGRAPHIC article on Eastern Europe's poisoned environment spotlighted the central Romanian town's plight. A producer of



carbon black for use in tire manufacturing, the town's Carbosin plant belched thick clouds of particulates into the air. White sheep had black coats, vegetation was stunted, houses wore thick layers of grime, and clothing had to be dried indoors.

The carbon plant was part of Ceauşescu's grandiose and heavy-handed plan to transform Romania from an agrarian country into an industrial dynamo. Although the plant has been closed and the air is visibly clearer, another offending factory. Sometra, remains (left, at top right). Housing lead and zinc smelters, it spews pollutants that irritate the throat and cause respiratory ailments, anemia, abdominal pain, and—some suspect—premature births and deformed babies.

economy has hung on long after the people spoke out—and it shows.

Petroșani, the cultural center of the Jiu River Valley, presents a comfortless skyline under a battleship gray sky. The city consists overwhelmingly of coal shafts and drab apartment blocks. None has a chimney: Home fires, I was told, were banned under communism so that miners would not be tempted to steal coal. The coal miner, the brawniest and most longsuffering of workers, always held a special place in communist iconography, and union bosses were prominent figures in the party apparatus. Six months after the 1989 Christmas uprising, Ion Iliescu, Constantinescu's predecessor, summoned miners from the Jiu to Bucharest. With crowbars and chains, they cracked the skulls of students demonstrating for democratic change, killing at least one and wounding scores of others. The man who led the miners was Miron Cozma.

At union headquarters in Petroşani, the entrance to which is flanked by two imposing black statues of miners in the angular socialist-realist style, Cozma showered me with gifts, including his book about St. Varvara, the patron saint of miners, and a tape dedicated to him by a heavy-metal rock band.

"We are more powerful than any political party," Cozma said, speaking of the tens of thousands of miners who make up the union he heads. When the conversation finally gets round to the batons and chains of Bucharest, he said, "I regret that very much. We were manipulated by those in power." (Cozma has since been arrested for the role he played in similar violence in 1991, though he continues to head the union.)

Ilie Martin, then the director of the Vulcan Mining Complex down the road, was less cautious in describing his motives. "We were the working-class police."

The descent into the Vulcan mine, a place populated by blackened faces and bright but distant eyes, begins in a crude iron cage. At the bottom rusty boxcars stand at the end of two tracks that disappear into the gloom of a low tunnel. "Do you smell anything?" asks Gheorghe Ile, the mine's technical director. "It's gas." If you lit a match in here, the mine could explode.

We continue along rotting wooden planks partly submerged in coal mud and water, our way lit only by our helmet lamps. Soon we're crouching, walking like apes, bumping our helmets against the roof beams. We descend into a tiny shaft down wooden steps, then a wooden ladder whose rungs are intermittent. At the bottom of a steep scree we enter a narrow gallery, which, after 500 yards, turns sharply into another. We squeeze through a hole and find ourselves in a damp tube. "We are at the coal face," Gheorghe announces.

Squatting among the wooden props that support the low ceiling, pickax in hand, is Marton Kato, eyes gleaming from his blackened face. "Hard to say which is worse," he says, "the work, or where we do it. But the danger is worse than either." There have been fatal caveins and explosions in this mine—indeed there was a cave-in on the day of my visit, but no one was hurt. But safety has improved, Miron Cozma told me: In 1971, for example, 103 men in his union's mines died; in 1985, 63. The average now is about 20 a year.

Kato is 30 but looks twice that. He and his co-worker Nicusor Butnariu, 24, have been working down here for five years. "You have to be fit—physically fit, psychologically fit," Butnariu says. "Never think about the surface, or your wife, or what you may do tonight. If the coal falls, the door closes. That's it."

The old guard had little interest in making enemies of what they still regarded as the "mass base" of its ideology—the workers in heavy industry—by streamlining the mines. Miron Cozma had pledged to protect the job of every miner but conceded, "I cannot assure work for the miners' children."

Then in the summer of 1997, soon after miners in the Jiu went on strike successfully for a pay increase, the government offered a severance package to miners who would voluntarily quit. The number of takers—about 15,000—reflects deep concerns about the industry's future. How these men will earn a living once they have run through their severance money remains unanswered.

Coal mining is something of a metaphor for Romania's problems. Constantinescu's hope is that Romania will play its products on the global roulette wheel of the free market. But recent efforts to convert government operations into real businesses may still leave Romania operating on the edges of commercial Europe, to which it passionately wants to belong.

landscape, it is easy to get luby the lyrical, pastoral countrys with horses and carts plodding the roadside, slowing things to rhythm of older times. Then you turn a corn and behold what Romanians proudly cal "chemical platform," or some such da satanic mill, which gives you a blast of sub dioxide. As you approach Bucharest, noxio punctuations become more frequent.

But the drab boulevards that lead into the city have, since 1989, sprung those first but of primitive capitalism and free expression that can be seen all over Eastern Europe: kind selling soda, chewing gum, candies, new papers, and pornographic magazines. A around, people are out strolling, frequenting the new cafés. Hard currency brought by foreigners, a source of money banned to ordinary Romanians under communism fuels some of this activity, and whatever had ships the aboveboard economy is suffering in the shift to capitalism, that which operate underground—notably prostitution and game bling—is thriving.

One way to start getting to know Buchare is to visit the previously forbidden corridor of the palace Nicolae Ceauşescu was building when he was deposed, now home to Romania parliament. Rising out of the cityscape through a sickly haze of morning sunshine and traff fumes, this enormous white wedding call of stone is one of the largest buildings the world. Ceauşescu destroyed much of o Bucharest to build the palace and Union Bo? levard—the grand street leading to it—as we as luxury apartments for his party faithful at the great piazza where he intended crowds gather and adore him. Nine years ago was forbidden to drive up what was then called Victory of Socialism Boulevard; now its mayhem of traffic, gesticulating police, and neon lights.

"It could only have been built by a dictator says Radu Cimponeriu, administrator of sprawling labyrinth of carved marble. "Yes is rather large," says Maria Atonache, one 122 cleaning ladies who work the building "But you get used to it. I clean here for thours a day, then get home and clean house. Mind you, that only takes half an house a bit smaller."

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Restarting from scratch, Tudora Margarit, 59, plans to raise corn on her once and future farm. In 1988 communist authorities seized her land and belongings and bulldozed her house into a pit. Under a restitution program she has regained much of her property.

A slaughtered sheep (below) helps provision a Gypsy festival. Ordered to settle in villages in the 1950s, the Roma still travel during summers, engaging in horse-trading and metalcrafts.







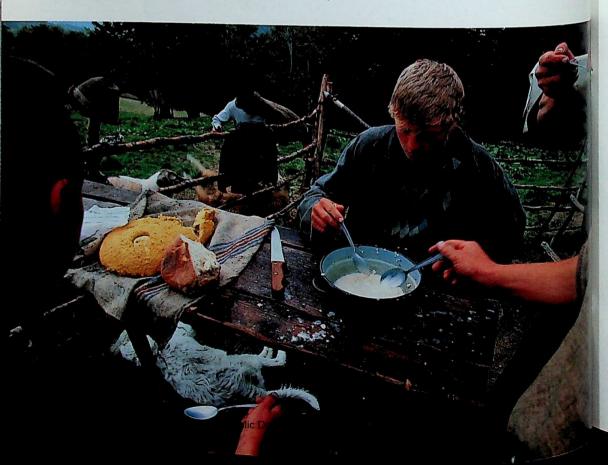
Swirling mists cast an eerie pall over the ruins of Vlad Dracula's castle. Born in Transylvania, , he reigned as a prince here in the region of Walachia. Though not a blood drinker like the fictional vampire, the 15th-century ruler was bloodthirsty—earning the epithet "the impaler" for skewering Turks and other enemies on stakes.

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rustic ways live on

Pockets of traditional lifestyles endured when unmolested either by collectivism or by Ceauşescu's crash urbanization scheme. In traditional dress for her wedding day, Maria Mihnea (above) poses with her parents and brother beside their barn in the village of Strîmtura as they await the groom's arrival. Near Botiza shepherds lunch on freshly made sheep cheese. After mountain grazing in summer, sheep are driven to lower elevations, and roadways countrywide fill with a roiling, baaing migration.



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ROMANI

Ceauşescu never fulfilled the fantasy around which the building was erected: to stand on the great balcony above the piazza, with half a million Romanians paying homage below. But years after Ceauşescu's death, throngs finally came to the palace to cheer. It was September 13, 1996, a Friday evening, and they gathered in good time, streams of young people, mostly girls, as the late sun caught the fountains. A spotlight was trained on the balcony, and to a crescendo of music and screaming, nearly two hours late, Michael Jackson walked out. He waved, mumbled something indecipherable about loving everybody, blew a kiss, and disappeared. Appearance time: 27 seconds. But there was no sense of disappointment. Romanians were tasting the forbidden fruit of Western decadence—and finding it sweet.

Police then cleared the streets, until the only children remaining, as on any other night in Bucharest, were those who lived there.

dren is the legacy of the revolution's single most unforgettable revelation to the outside world: the prison camp orphanages in which infant waifs—starving, filthy, often dying from AIDS—were discovered chained to cots. A flood of Western money went to alleviate this suffering, and the orphanages accordingly improved, some beyond recognition.

So now a knock on the door of the Pinocchio orphanage, a name given because of its child-friendliness, is answered by Sorina Chivoiu, who talks about "getting some kind of modern social service mentality rooted in this country." The institution, run now not by the state but by the elected Bucharest city authorities, is clean, its walls lined with children's pictures. Nevertheless the word orphanage is a politeness—in reality, this place is a dumping ground.

Sorina points out Radu, a five-year-old with a cheeky grin. He was found at the age of two at a Bucharest railway station, where his father had left him with a note round his neck, "abandoned by mother." "It took two and a half years to identify him," says Sorina.

About 100,000 children live in institutions in Romania, but many of those abandoned by their families do not. "Most orphans end up being adopted by the street," says George

Roman, an organizer for Save the Children, whose volunteers scour a subterranean demimonde in search of abandoned children who live rough, trying to rescue those who appear unable to survive.

In a New Year's address after his election, President Constantinescu said he wanted to draw people's attention to what is still Romania's sad reality. Numbers are hard to determine, but children's groups estimate that some 4,300 youths now live as street children, mostly in Bucharest. The country has the highest number of pediatric AIDS cases in Europe; during the communist era, clinics reused hypodermic needles when administering vaccinations against childhood diseases, and blood used in transfusions was sometimes contaminated. There is also a high incidence of AIDS among children born or made homeless after 1989, says Miralena Mamina, the Bucharest program coordinator for Save the Children. "It is because of their sexual activities," she says—a euphemism for child prostitution.

Where there is evil, there are usually angels too. Just past the midnight hour, when Anca Dionisie, 24, a volunteer for Save the Children, strides into the forecourt of Bucharest's main train station, children rush toward her, their miserable world illuminated. Ruffling their matted hair, she cuddles them, even kisses their sores. "I have no politics or religion," she says. "I just work against any world that thinks children can be thrown on a garbage dump and treats them as though they are guilty of something."

Anca says to me, "Come, I want you to meet some interesting people." We journey through the cold, rainy, foggy night to a new drive-through McDonald's—a shining altar of change. She lifts a manhole cover in front of the building. Through the opening in the tarmac comes a jet of hot, putrid air, into which we descend down a long ladder set into the concrete shaft. It takes awhile to become used to the darkness, but the light of scattered candles slowly reveals a nether scene straight out of Dostoyevsky. Huddled in corners of a brick chamber or perched asleep on coughing heat pipes are children, about 15 of them.

Anca introduces Laurențiu, a leader of this group. "I've been on the street for 12 years, but things are different here," he says. "Most of these children have lived up at the station

and have come here to try and change their ways. Our rules are that if you steal, you're out. If you sell your body to the foreigners, you're out." At 22, Laurenţiu—weary and wearing a cross around his neck—is no child, but the others range in age from 8 to 17. Most live by begging, but a boy called Carl, 14, has found a regular job loading goods at the railway. At about seven each evening, he returns "home."

This little community is barely hanging on, as 17-year-old Florentina, sitting up in the car park, demonstrates. Florentina has deep eyes and sharply sculptured cheekbones, yet her natural beauty is marred by the sores on her face, which is as red as boiled lobster. Before speaking, she fixes a plastic bag full of warm glue to her mouth and inhales. "A man wanted to have sex with me," she says. "I was afraid to go with him, so he raped me. I didn't want to go home. Here they leave me alone."

As Florentina's eyes glaze over, Laurenţiu's voice comes from the depths beneath the manhole. "Florentina! Come out of the rain!"

HE LIGHT of a quicksilver moon dances on the turquoise water of the swimming pool. At an outdoor party in a Bucharest setting that Laurenţiu and the others can only dream about, the selection of drinks is estimable—including tequila for the toast to our gracious host, Vijai Gill, head of Pepsi-Cola, Romania.

"That was a great day when we launched Pepsi Max," says Vijai. "Music, thousands of teenagers, and the president of the company over from the U.S. When they opened the sampling booth, we nearly had a riot on our hands. I remember a woman of 60 fighting through the crowd to get a can of Pepsi Max."

Most of Vijai's guests are expatriates working for Western companies. They seem little impressed by the first signs of Romanian privatization—"the old guard selling industries to themselves," an Italian financial consultant says. There is reason enough for suspicion. For instance, the Păunescu family, a weighty dynasty under Ceaușescu, bought the franchise for the Bucharest Inter-Continental Hotel, and the state banking industry has been weakened by a series of scandals allegedly involving massive fraudulent loans by directors to themselves.

One guest is Radu Florescu, son of a his rian of Dracula (the real one). Florescu he the Romanian branch of the Saatchi & Saa advertising agency, handling the account Kent cigarettes and Hewlett Packard, amothers. "Brand names mean something he says Florescu. "Take detergent. People will a box of Ariel, then Bona, a cheaper he brand, after that. But they'll still pour the brand the old Ariel box so visitors will they're using Western soap powder."

As the commercial landscape begins change, however slowly, something dramatic happening in villages such as Vlădiceasca Ciofliceni. During the 1980s these rural sett ments disappeared, literally, plowed into ground on Ceaușescu's orders. And where the stood, grain was planted, as the communegime chased productivity targets set by the "cultural revolution" on which Ceauşes embarked after a visit to China.

The peasants in these villages we wrenched from the confiscated land the ancestors had farmed for generations, form by the authorities into drab high-rise apartments, and left to languish. One of the earlest—and most convincing—indications Romania's emergence from communism can in 1991 when Ion Iliescu's government decreated that the peasants could take back their land albeit without compensation. Many have turned from state farms and high-rises to land where they and their forefathers has scratched out a living.

Outside the village of Ciofliceni, a hear ening sound is coming from the place when on February 27, 1988, Gheorghe and low Paun's house was razed. It is the banging of hammer, as Gheorghe rebuilds the barn when his cows and pigs will pass the winter, the Pauns' first back home.

"They did it bit by bit," says Ioana, descring how the local authorities forced them of "First they wanted our orchard, then our siden. They gave us 36 hours to leave the house We watched them dig a big hole, pull even thing down, including the curtains, and hold doze it all into the hole."

The apartment building—a nondescription of the family was not even ready," says Ioana. Was no roof or water or electricity."

Gheorghe was given a job in a local factor

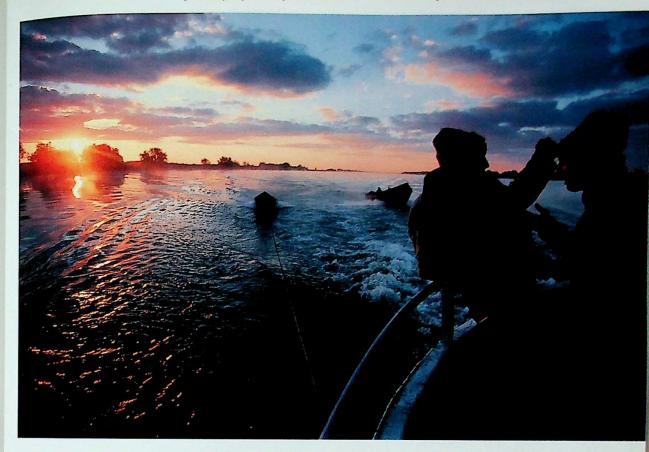
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ROMAN



Dawn's glow silhouettes ferryboat passengers in the Danube Delta, one of Europe's largest wetlands and the target of a belated pollution cleanup. Ceauşescu ordered huge swaths of the delta diked for farmland, another misadventure being reversed as Romania sets sail on a new course.

and every day the bus took him past the field where his house had stood. "It was wonderful to come back," says Ioana. "We had lost touch with our neighbors—but here we are, neighbors again."

The Pauns' two acres or so are planted with tomatoes, cabbages, grapevines, and eggplants. Their new house, made of mud bricks, plaster, and straw, took four years to build; it is neat, with whitewashed walls. But, says Ioana, producing photographs, "It's not the same as the old house is it?" She pauses. "But it's the land that matters. I like to work the land, that's what I was born for."

HILE THE NEW ROMANIA has brought Ioana Paun back to her scrap of land, upon which she says she will die "a happy woman," for many Romanians changes have had the opposite effect. The new world is a broader one, made of distant, calling horizons.

In the days after the 1989 revolution when I was in the art museum with Codruţa Cruceanu, the expert in Flemish painting, there had been a joke at my expense. I'd asked Codruţa if she'd ever been to Flanders. "The very fact that you ask such a question," she scolded, "shows how little you understand what communist Romania was like." Until then, Romania had been a country in which every typewriter was registered with the police, and it was forbidden even to talk to foreigners without government permission.

Six years later we walked down the same corridor in the museum, which had been restored. Codruţa was now the head of publications and works on international projects. The building glistened. Early morning sunshine stroked the square below, crowded with people in brightly colored clothes. Now it seemed fair to ask, "Have you been to Flanders since the revolution?" "Many times," she replied. "And I'm off to Italy tomorrow."

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SLOW AND SPOOKY, an 11-foot shark cruises past a submerged ice ledge where seals often rest. Never before photographed beneath Arctic ice, the Greenland shark, whose scientific name, Somniosus microcephalus, means "small-headed sleeper," has eluded close study until now.

GreenlandS

Digitized by Arya Samaj Foundation Chennal and eGangotri

Sharks

Article and photographs by NICK CALOYIANIS

Digitized by Arya Samaj Foundation Chennai and eGangotri

SWAM THROUGH A FRIGID CONSTELLATION of tiny plank ton, swirling around me in a half-lit universe beneath the surface at Arctic Bay. I'd been down there nearly two hours far too long, even in a special cold-water dry suit. My finger were numb. On the verge of hypothermia, I was feeling light headed. It was time to go topside. I'd spent two long August weeks on Baffin Island in northern Canada, waiting for a seemingly endless string of storms to pass so I could go diving. I was in search of one elusive creature: the Greenland shark, the only shark hardy enough to live in these 28°F waters. My trip was nearly over, and now bitterly disappointed, I had to give up and go home.

But wait . . . was I hallucinating? A dull outline formed in the murk distance. It was a long animal. Huge. My diminished senses perceive it to be a narwhal, without its unicorn-like tusk.

Forget the cold. I kicked my fins and swam toward the shadowy figure. It turned and began moving toward me. I was face-to-face with a Greenland shark. I'd seen drawings and paintings of the fish, but this was utterly different. It was ghoulish. Its nostrils were the larges I had ever seen on a shark. They reminded me of a giant doublebarreled shotgun. Its mouth was slightly open, revealing rows of smi

> sharp teeth. Its eyes looked fogged over, like those of a dead fish, and from each one dangled a tasseled parasite called

> > I'd almost forgotten that my sole reason for being here was to take the first images ever of the Greenland shark by a diver. I quickly aimed my camera, focused, checked the exposure, and then gently depressed the shutter release. But there was no click. Instead the "low battery" indicator was blinking. The 🕬 water was taking its toll not just on me but also on my camera's lithium power source.

> > > I turned the camera off in hopes that enough energy remained in the system for the exhausted battery to recover.

The shark then headed over to a mesh bag of bait I'd placed nearby and sucked it in like a big gray pool vac. I couldn't believe this. I was staring at the one thing I wanted the most, and now a ten-dollar battery

was holding me back. A minute passed. I switched the camera back on. Power! Enough for two shots. The shark showed renewed interest in me. Afraid it would suck me into

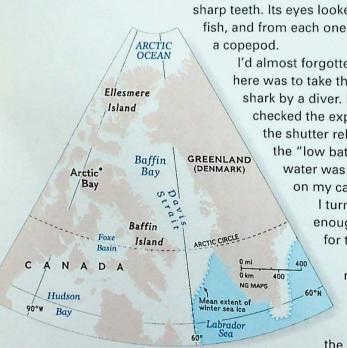
its menacing maw, I backpedaled furiously toward the surface.

"I found the shark!" I yelled to a colleague on the shore. This expedition was over. But, my hasty photographic efforts aside I still wanted to document fully this eerie predator in its underwater lair. And so the following spring, accompanied by noted shark parasitologist George Para tologist George Benz of the Tennessee Aquarium—and toting lots of fresh batteries—I returned to the Arctic, now covered by ice.

We waited. But not for long.

Filmmaker and photographer Nick Caloyianis documented mating nurse shafts for the May 1995 issue. He lives in Caloyianis documented mating nurse shafts for the May 1995 issue. He lives in Baltimore, Maryland.

"It rose up and hovered near me in an almost vertical position," says diver Clarita Berger. "When I saw its mouth starting to open, I got concerned." But there is no record of Greenland sharks ever attacking humans, and a nudge with a strobe light sent this one into retreat.







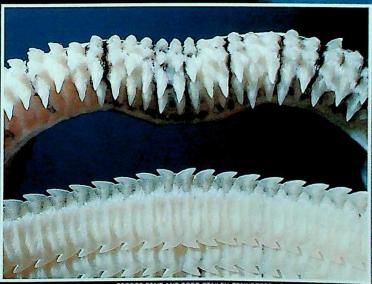
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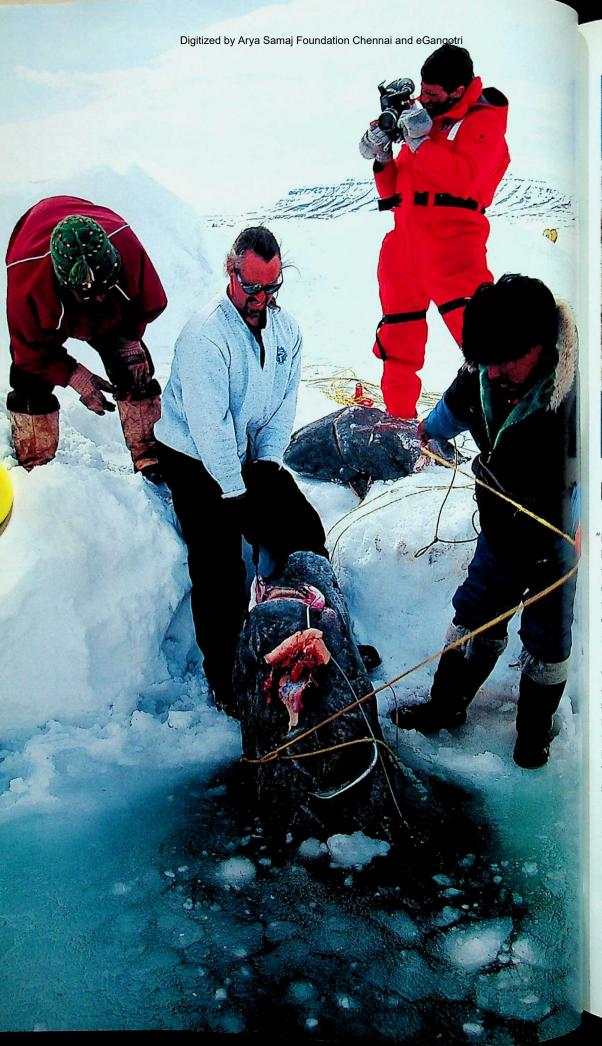
oy Arya Samaj Foundation Chennai and eGangotri

The Business End

A SERRATED lower jaw slices through prey held in place by the dagger-like upper teeth (right). Rather than losing one lower tooth at a time, the entire array drops out and a new band shifts forward. The lethargic shark eats seals, fish, ^{and} carrion, sometimes by ^{opening} wide and sucking in its prey. "We lured one with a three-foot mesh bag of bait," says author Caloyianis. "The shark inhaled it from three feet away."



GEORGE BENZ AND TODD STAILEY, TENNESSEE AQUARIUM, CHATTANOOGA



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Dine at Your Own Risk

"DRUNK AS A DOG," the Inuit like to say. The phrase comes from the behavior of sled dogs after they eat the raw flesh of Greenland sharks, which often contains a strong neurotoxin.

One of the few ways to detoxify the flesh is to soak a dead shark in salt water for several days—an approach tried by researchers who then fed the carcass to a team of hungry sled dogs (above). They showed no adverse symptoms.

"We later saw a dog that had fed on a newly killed Greenland shark," says Caloyianis. "It appeared inebriated. It couldn't stand up."

Poisonous flesh doesn't stop Greenland sharks from cannibalizing each other, as marine biologist George Benz (left, in white) observed when his research team pulled in two sharks they had hooked through a hole in the ice. One was devoured up to its head.

Among the world's largest sharks, the Greenland is nevertheless among the least studied. Records show a 21foot-long female caught in 1895 off the east coast of Scotland, but Arctic specimens measured on the ice (below) reached only 7 to 11 feet. There are no reliable data on life span, but fully grown Greenland sharks have been recaptured 16 years after being tagged.



Losing Sight to a Parasite

TURNING A BLIND EYE to hitchhikers, almost all Greenland sharks host tiny crustaceans called copepods that attach themselves to the sharks' corneas, severely damaging their eyesight.

Magnified under an electron microscope (bottom right), the three-inch invertebrate exhibits two clawlike appendages that grasp the cornea.

The anchoring process creates a scar, and additional lesions occur as the copepod's body scrapes back and forth across the cornea while



the parasite feeds on surfacelayer cells. Before long, the abraded cornea fogs over.

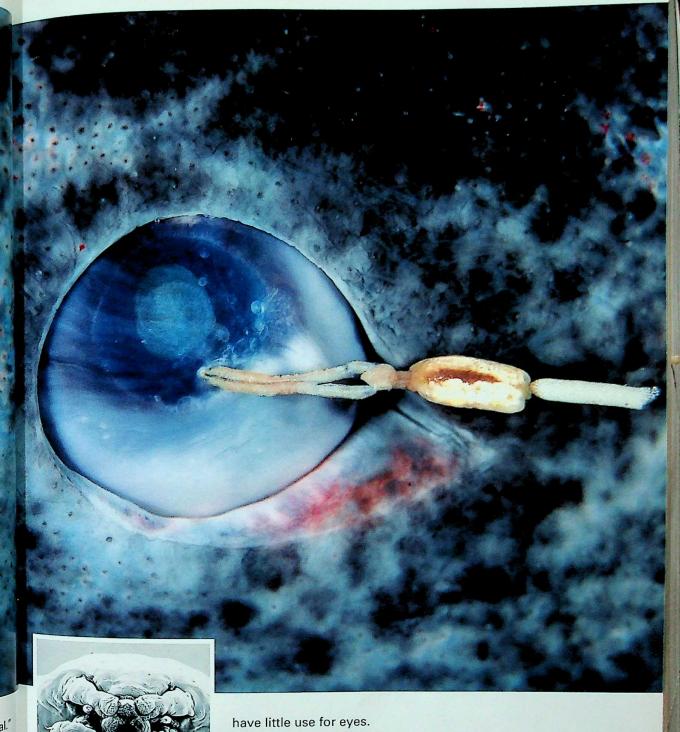
Dangling like a worm (top right), a copepod trailing an egg sac clings to a Greenland shark's eye. The fish's pupil can be seen behind the clouded cornea.

"The shark's eye still moves about," says Caloyianis. "The lens itself at least seems to stay functional."
In a lens removed from a Greenland shark (above left researcher Benz's inverted image is clearly visible, leading him to believe the shalk could detect light.
In any case, because the shalk could most of their time.

In any case, because the spend most of their time in darkness, sometimes at ocean depths reaching 7,200 feet, these sharks seem to

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have little use for eyes.

Scientists speculate that the copepod may actually aid the shark in feeding. Fish may be attracted to the parasite, which moves like a fishing lure when the shark is swimming.

Although the shark's vision is severely compromised, it retains a keen sense of smell to seek out prey.

JEFFREY BRASWELL, DUPONT

GREENLAND SHARKS

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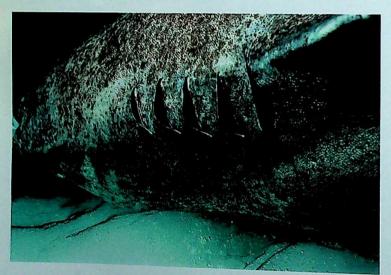
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No Frills Fish

TETHERED for close observation, a Greenland shark heat for the depths moments before it is released (right). Well adapted to life in frigid dark waters of the Arctic and Atlantic, the seemingly primitive Greenland shark probable evolved from an ancient deep-water species.

Its dorsal fin (left) is far les pronounced than those of more active sharks, including some of its dogfish kin. The shark's gill slits (center) are smaller than those on most other sharks; they may boos suction for feeding. The author was surprised to find a horizontal ridge called a caudal keel—usually found on faster swimming sharkson its tail (bottom). This led experts to think he had discovered a new species until Benz found a reference to the keel in a decades-old text.

During World War II the Greenland shark was hunted for its liver oil—valued as an airplane engine lubricant

Its tissues have a high use content, giving rise to the lo legend of the shark's origin. An old woman washed her hair in urine and dried it will a cloth. The cloth blew into the sea and became the first Greenland shark.

Today the Inuit disdain this curious creature, which they consider a useless nuisance that scavenges their food.



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By EDWARD HOAGLAND Photographs by MICHAEL YAMASHITA

The same picket fence that lets spring in can't shut winter out in Vermont's Northeast Kingdom. Winter rules here, but the rest of the seasons make up in splendor for what they lack in length. "At times there's a luxury in the beauty, and at other times an austerity," says a local poet. "But it's always there."



of Seasons

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QUEBEC Northeast VERMONT

UR NORTHEAST KINGDOM" was originally Senator George Aiken's phrase, referring to the least assimilated corner of his state of Vermont, lying next to the Quebec border and the headwaters of the Connecticut River in northern New Hampshire. In fact the springs on my own hundred acres in Caledonia County flow into Canada and the St. Lawrence River, but if I walk a couple of miles through the forest, I'll find running water that heads toward New Hampshire and south to Long Island Sound.

In Essex County there are bog-and-forest townships with fewer human beings than I have fingers, and in my sprier days I've climbed its mountains—Gore and Stone and West and Seneca and Starr and Bull-camping on top with my white collie mongrel, Bimbo, and a brown hiking goat named Higgins. We three visited Maidstone Lake and South America Pond, the Yellow Bogs, Ferdinand Bog, and the forks of the Nulhegan River, Victory Basin, the Moose River, and lovely Paul Stream, though the paper companies have since logged these places heavily. Oddly enough, wild woods and backwoods towns are now associated with innocence and restfulness, a hideaway in which to "recharge," whereas they used to be

Essayist and novelist EDWARD HOAGLAND has had a farmhouse in Vermont for 29 years. MICHAEL YAMA-SHITA last photographed the cycle of the seasons for his book In the Japanese Garden (Starwood, 1991).

regarded as benighted, incestuous, or brutal.

My own little Wheeler Mountain, scarfed and skirted with clouds, looks off southeastward to the massif of the White Mountains, clustering about Mount Washington, 70 miles away; and west to the gentler north-south spine of the Green Mountains—Camels Hump, Mount Mansfield, Jay Peak—or to a vista of the Sutton Mountains in Quebec. A 45minute scramble rightward from my front door brings me up to the bare granite pitch where these sights are at hand. But if I veer left from my house into the fern gardens and tangle of behemoth blowdowns under a tall fir woods, I come to juicier spruces surrounding a small fen of succulent swamp bushes and grasses and birches and poplars, with curling trickles that feed into it from groundwater seeps in the ledges above. This sanctuary is where a cow moose gives birth to a calf every spring, and tracks regularly show that a bear family has ambled down from the ridgetop to drink from the stream and paw the windfalls for ants or nip off vegetation. In a sandy wallow I'll find black hairs floating in the turbid water, as if the bears have just jumped out. In a nearby maple and beechwood flat I was once challenged by the mama, after she'd put her cubs up a tree. She kept bluffing me, lumbering at me several times, chopping her jaws, but when I stood still (loyal Bimbo next to my thigh), she broke off, brought

them down again, and shepherded them of

That was the same walk when, earlier, I'd found a 19th-century apothecary's bottle, w raised lettering on the glass, in an old cellar hole and stuck it in the crotch of a big tree safekeeping, sure that I'd find it again-but course, never have. Jack-in-the-pulpits grow near that cellar hole and pitcher plants in a boggy sort of catchment a stiff climb up, new where a coyote family dens, which my neighbor and I listen to at dusk when he plays his harmonica. The coyote pair or the bear coul kill a newborn moose calf, but the special tue of this swampy cul-de-sac is that it's 50 ripe with moosewood, Solomon's seal, wool sorrel, bearberry, willow shrubs, and all sort of other stuff the mother moose eats that \$ doesn't wander far. Then after a month, what the calf is sturdy, she brings it on a path pas my house, migrating to a big valley (called Valley) where other moose hang out.

I tend to hang out near my pond ("earth" eye," as Thoreau called his), with its green pickerel frogs, its woodcock in the alder this ets hunting worms, its kingfishers and goshawks swinging through for an occasional meal, and the bull moose that descends and soaks himself on hot days. Or I'll climb to open-faced shallow cave, shaped like a band shell, in a wild little notch overhead, with sky's eye view overlooking a deer path, and lie like a mountain lion on the sandy floot



Sugar maples shade a quiet country road on the Gonyaw farm. Each year Alice Gonyaw makes sweet, amber syrup in this 1,800-tree orchard, just as her father did, and his father. For Alice these trees mark the seasons, and when the sap flows, "that's a sure sign of spring."

sheltered by the undergrowth and forest all around-maybe sometime real lions will be able to return. The summer gets so green that when you close your eyes, the cedars, hop hornbeams, and mossy patterns on the ground remain imprinted inside. The tentative dawn, with skating, humid clouds and spates of rain in squalls, then a sky blue that lifts everybody's heart are wonderful enough but only accompany the welter of oak, apple, and bigtooth aspen greens, and pasture roses, purple vetch, mallow flowers, and brown-eyed Susans. Everything is moving, fattening, the plants in the wind, animals on their own four limbs, in this interval of extraordinary surplus when berries fall and simply feed the worms.

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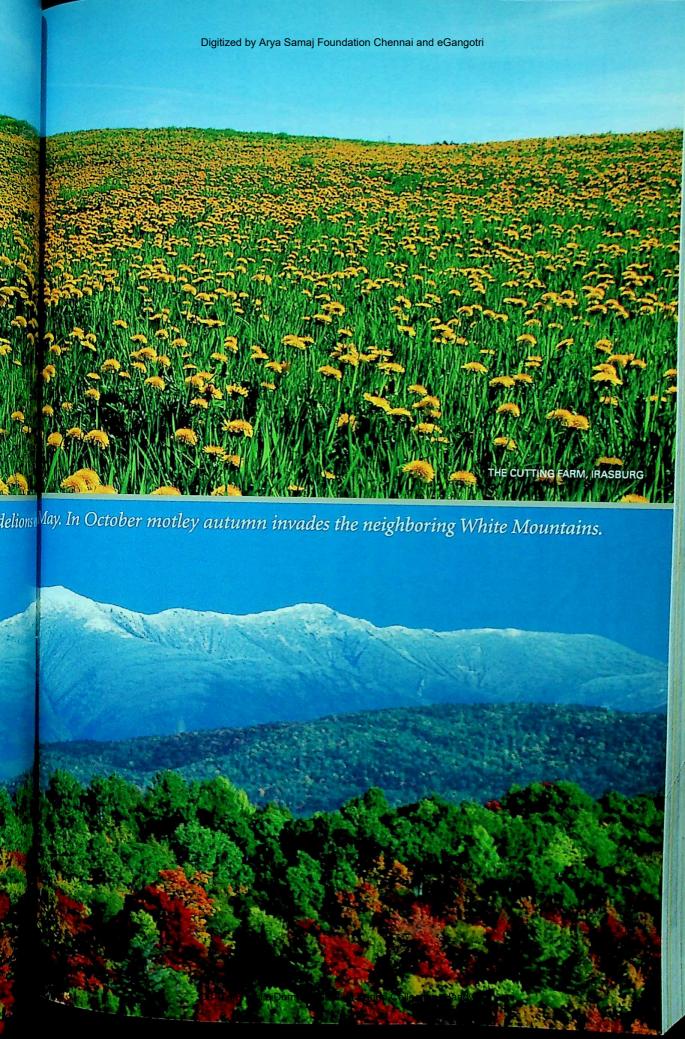
The fall as it waxes cuts crisply into this bounty. The barn swallows leave at the end of August, heading for South America even before the insects they feed on have disappeared. The birds had preempted the sound waves from the frogs during May; then insects took over the main singing duties in August. But all fall silent when the first killing frost lies knife colored on the fields, come morning, as the summer creatures hug the ground underneath for some relict warmth. Mammals, however, just fluff their fur, and deer get in rut. Mammals don't fly or breed in profligate numbers, so they make much less noise and tend to accomplish their courtship or territorial behavior with scent marks and body

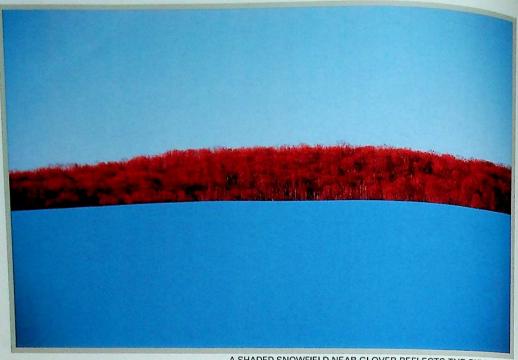
language. Silence is the mammalian mode, unless they lose their heads like a bugling buck.

During hunting season any surplus deer will be forced off the hill into the buzz saw of road traffic and close-set homes with bow-and-arrow enthusiasts peering out the windows, and the coyotes get to feast. Ten or twelve deer in the particular herd I'm familiar with generally survive, and they gather openly when the gunfire ends, as if taking stock and bonding again—as they'll do four months later, when the ordeal of winter weather ends (the rest of us, like the mythical bear, have been sucking our paws for nourishment).

INTER defines how much wildlife 'raw land," as the farmers call it, can carry. When winter shuts in, the food supply crashes, and many denizens, such as bears, chipmunks, groundhogs, jumping mice, and reptiles, go underground, or else fly south. The snowplow and woodpile become talismans, like the interplay of light off steep angles of white, gray, black, or softwood green, and the endless off-white mounds of snow, ambiguous as a surplice, may look chaste or corpse-like, funereal or energizing: Is it for a wedding or a death? Snow slows life, grinds a bit out of you, probably forever, and Vermonters call themselves "woodchucks" because they've learned to hibernate under the weight of it instead of fighting for primacy, as







A SHADED SNOWFIELD NEAR GLOVER REFLECTS THE SKY ABOVE

newcomers do. It puts a damper on some of the extravagances of sunnier climes, the doubled-up bankruptcies, divorces, and such.

Life is piebald in New England, like the fields in the spring and fall—part warm earth and part ice and snow. The deer may be staggering from malnutrition by the time the snipes come back to winnow in lariat loops in their courtship flight across the evening sky, and the whickering woodcocks begin stunting too, in funneling spirals, as the ravens and owls, year-round residents, chime in.

Though Vermont is a small state, its moist, loping terrain, full of choppy mountains and meadowy woods, supports a scrimmage of wildlife in pocket habitats. Killdeers, turkeys, turkey vultures, great blue herons, yellow-throats, rose-breasted grosbeaks, broadwinged and red-tailed hawks, red bats and hoary bats, smoky shrews and short-tailed shrews, red-bellied snakes and green snakes, spotted salamanders, meadow voles, hairy-tailed moles, and star-nosed moles—what haven't we got in Vermont?

You can set your calendar by when the big snapping turtle crosses my road to lay her eggs every spring. Earlier, the red squirrels had telegraphed when the maple sap started to me by dashing up the trees and nibbling twigs. Then, by and by, the yellow-bellied sapsuckers drilled holes in the bark to lick the sweets, with hungry hummingbirds freeloading behind them. My fox family overlaps with my skunk family and raccoon family in foraging. They gingerly bypass each other in mouse-hunting, grub-eating, berry-gobbling expeditions, grabbing a crippled songbird or an incautious garter snake and devouring it quickly lest the competition horn in. Foxes race and pounce, skunks scuttle and dig, raccoons employ their flexible fingers for culpurse prying.

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The deer and moose, too, overlap throughout the summer in crossing my fields, though the deer, more vulnerable, winter beside the stream low in thick copses that shelter them from the windchill and deep snows, while the moose, longer legged and tall, climb up near the ridgetop to tough it out in less protected places, where their ancient enemy, the wolf, would have a harder go. In the stream, news and two-lined salamanders also share adjoining habitats. The newts swim judiciously in the slow, greeny amber stretches, while the

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GRANITE CLIFFS FLANK LAKE WILLOUGHBY IN WESTMORE.

two-lined salamanders hide under rocks in faster water, limited to a few feet of navigable territory but with more insects to grab, tumbling by.

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At the pond, which I had dug a decade ago (the best \$110 I've ever spent), already four kinds of frogs breed—green frogs, pickerel frogs, gray tree frogs, and spring peepers. The tree frogs in a June rainstorm will pipe up, safe in their willows after leaving the breeding pool, as if notifying one another where they have ended up. Frog music, in fact, was why I wanted the pond, and I've been careful not to transplant any fish or turtles into it that might eat the eggs. Toads lay eggs there as well, so five kinds of watery songs now enliven the spring dusk for me, not counting the wood frogs' clucking calls, which briefly in April resound from shallower, rain-fed temporary pools. I worry about them because their voices have noticeably thinned in the annual songfest, and I come across fewer hopping through the moss in my walks later on. Like the wandering wood turtles—also severely depleted in recent years—you don't see them much in my neck of the woods. Terrestrial turtles ^{every}where are getting run over as roads

crosshatch the places they live. But with the wood frogs, the prime disaster appears to be acid rain; I've done pH tests on the evanescent breeding pools that fill with the spring showers and found that they have become as acidic as tomato juice, whereas the spring-fed, permanent ponds where the other frogs breed are still in the healthy range.

PEOPLE OVERLAP TOO. Summer folk pay taxes on lots of land they vacate on Labor Day, whereupon the guy living in a double-wide trailer with a plywood extension built onto it, near town, may come out and make the place his own—collect the cider apples, nail deer stands in the trees, cut balsam boughs to twist into Christmas wreaths, lay out a trapline for beaver, mink, and bobcat, and run some bear hounds through and sell the bear's gallbladder to Korean medicine men.

But after Memorial Day weekend, all seems politically correct on the place again. The defunct farm becomes a stage set for modern morality plays: Repairing a marriage or starting afresh, recapitulating for one's children the pleasures of sunfish fishing, flower pressing, butterfly collecting, rabbit raising, or Orion

VERMONT: SUITE OF SEASONS CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar

ow varied the hues of the brilliantly lit water," wrote poet and native

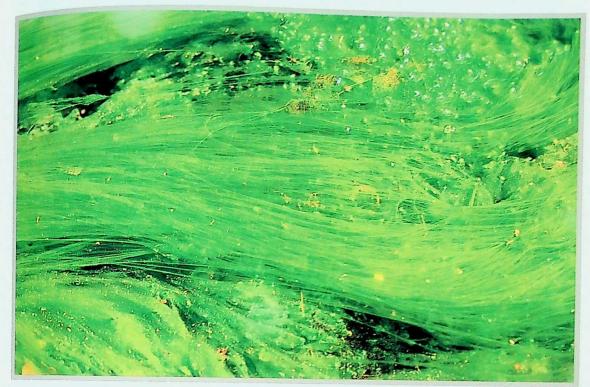


POND BROOK, BARTON



HOLLAND POND, HOLLAND

son Leland Kinsey. "All the rainbow colors . . . into the ultraviolet and infrared."



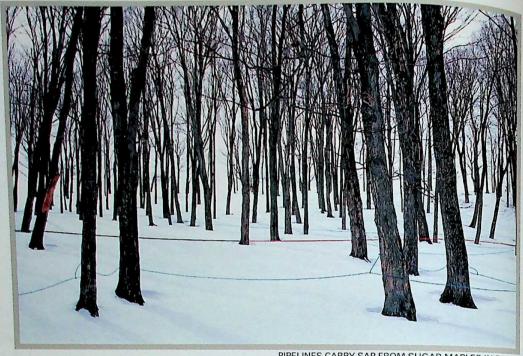
BOILING SPRING, SUTTON



ALDER BROOK, HARDWICK

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native



PIPELINES CARRY SAP FROM SUGAR MAPLES IN DERBY

and aurora and star gazing, skinny-dipping, home canning, or whatever else may eventually instill in them a feeling for nature. Or one just holes up in temporary solitude as a tonic because it's stabilizing.

In Vermont we know that the Earth spins when the weather comes on hard, usually layered, never glossy or flagging. Bruise-colored, steel-colored, quilted with thuggish thunderclouds or smothering snow clouds—till it lets go for a while, showing the sunny blue or galactic black beyond. I don't believe one can live fully if one is afraid to die, and I don't meet many Vermonters who are. Being outdoors in all seasons, they take nature for what it is, all-encompassing and yet cyclical, fecund, rhapsodic, but then chilling and killing, until the next year. Though you drive carefully, of course, you don't expect to count as an exception. Like the maple woods, you will turn dramatically orange in the face some fine day, and then quite white and very still.

This is not a spot for high hopes and long horizons: The question is whether that wee snowstorm is going to hit tomorrow, or that broken culvert is finally going to puncture your front tire, or that wet hay is going to decompose and set the barn on fire. Yet the lilacs do bloom every spring; the mama snapping turtle crosses the road at the same point to lay her clutch of eggs in the sandbank again.

Rock-ribbed inertia or faith kept the human Vermonters here too—steaming cedar boughs for liniment oil, digging ginseng roots, trapping fox fur, tracking wild bees to their honey hives, besides the main business of milking cows, churning butter, peddling cottage cheese, logging yellow birch to haul to the mill, maple sugaring, and cutting Christmas trees. My predecessors on this farm did all these things (and sold corn whiskey and lived a lot on deer), improvising to make a go of its since it was so stony, steep, and cold.

Most creatures—not just us—defend a piece of property for themselves: birds, bull-frogs, bears. Every cherry season I listen to the mother bear that dens nearby defend her cubs' food sources on my land from other bears drawn off the ridgeline by the scent of fallen apples and wild cherries. Growling loudly, she warns them away, much as the coyote family will drive off a bachelor coyote from their rabbit pastures by howling and threatening an attack or a nesting meadow

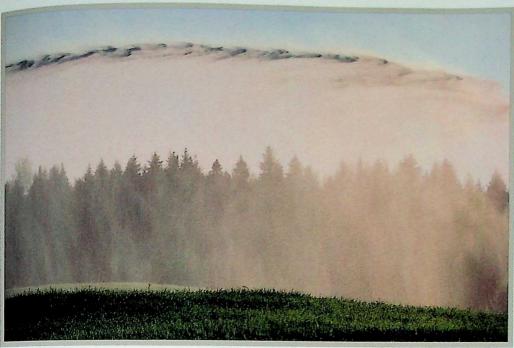
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A SPRAY OF DAIRY BY-PRODUCTS FERTILIZES A FIELD IN CABOT.

mouse will assault another mouse that blunders by. She's paid the property tax on three yards of grass and tolerates no trespassing by her own species, until the weasel finally tracks her down and sucks her throat. Yet the elasticity of the arrangement is such that the land gets layers of use, its mounting undulations hosting whole cycles of flowers, butterflies, the wealth of ostrich ferns, lady ferns, cinnamon ferns, and sensitive ferns; the ash and butternut trees, basswoods, diamond willows, slippery elms, bigtooth aspens, beeches, and hazelnuts; wood thrushes, scarlet tanagers, cedar waxwings, and porcupines.

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HEN YOU DEVOTE time enough to looking at a mountain, it becomes a bit chameleon—clouding over, changing color, its cliffs turning convex or concave according to the slant of the light. The trees are miniaturized, yet you think you know their patterns, the pale patches of quaking aspen and dark green seams of red spruce. But then you realize that your geometry is incomplete: Trees you didn't know about have grabbed a foothold in the interstices of one shoulder or on the brawny, cryptic face.

Climbers test their craft on one giddy pitch of Wheeler Mountain, while others use a scrabbly, more forgiving trail to introduce their kids to the gentle sport of scrambling or to lead their friends and spouses up to the same exhilarating end point, where you can gaze across at the White Mountains in New Hampshire or the Sutton Mountains in Quebec. A five-mile glacial lake lies below. The precipice the alpinists practice on is like the blunt forehead of a sperm whale, and its highsloping, forested back is where the rest of us will hike on balmy Sundays—otherwise a rendezvous point, banded with mists, that coyotes howl from, bobcats scream from, bears and moose and snowshoe hares and red-backed voles shelter on. I never tire of looking at it.

A quarter century ago, I remember, Carl Wheeler, son of the man the mountain is named for, had a heart attack at 84. His wife, Dorothy, called for an ambulance on the CB radio—there are still no phone lines here. Typically for a small town, his nephew came, and as Carl's stretcher was being slid into the back, Carl asked that everybody pause a moment so he could have one last look upward at what he was leaving behind.

VERMONT: SUITE OF SEASON CO-0. In Public Domain. Gurukul Kangri Collection, Haridwar





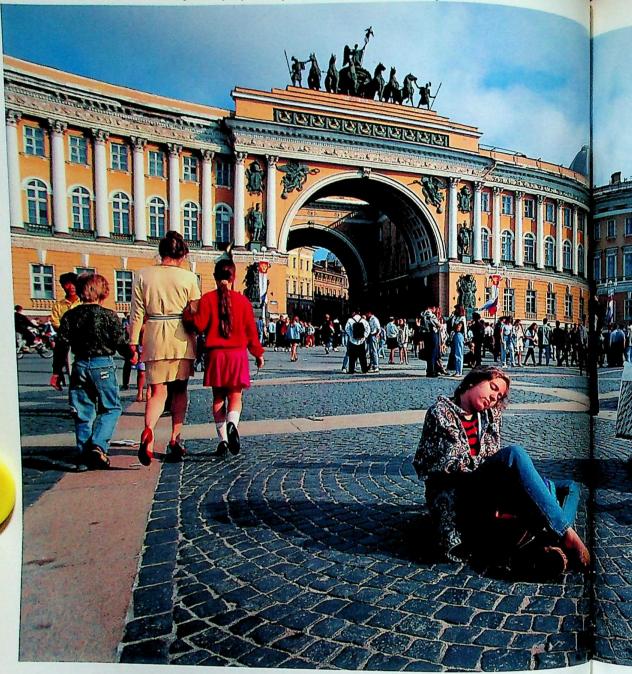
SHADOWS IN THE SNOW, two women nearing St. Basil's Cathedral cooke the night in 1744 when a 14-year-old German princess, hoping to wed the future toar, arrived in Moscow with her mother. Resolved "to perioh or to reign," the girl became empress—and one of Russia's most controversial reformers.



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By ERLA ZWINGLE Photographs by SISSE BRIMBERG German. She had absolutely no legal claim to the Russian crown. She endured 16 excruciating years waiting for her cruel, mentally subnormal husband to become tsar; six months later she overthrew him in a coup; a week later her guards murdered him. She claimed to espouse the ideals of the European Enlightenment, yet she tightened the grip on the serfs so far that they rebelled in the greatest Russian uprising ever before 1917. Claiming to love peace, she oversaw seven wars and masterminded the complete dismemberment





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As alone as this woman seems in St. Petersburg's Palace Square, Catherine (below) for years endured the disdain of her husband, heir to the throne, and the suspicion of his aunt, the empress. In books she found solace and the ideas with which she would try to remake Russia.

of Poland. We'll discuss the lovers later.

Yet Empress Catherine II ruled for 34 years, one of the longest reigns in Russian history, and not long after her death in 1796 a Russian historian wrote to her grandson: "Should we compare all the known epochs of Russian history, virtually all would agree that Catherine's epoch was the happiest for Russian citizens; virtually all would prefer to have lived then than at any other time."

Today judgment is considerably more mixed. There is no single great event that defines Catherine's reign, no epic deed that still excites admiration. Even in her lifetime Catherine had furious critics, who saw her as a bloodstained usurper and opportunist; she also had passionate defenders—foremost among them Voltaire, the French philosopher, whom she manipulated by shameless flattery and lavish presents and who responded by idolizing her and acting as her personal publicist to all of Europe.

The shortest possible summary of her reign would include, on the positive side, her wars with the Turks, which gave Russia the Crimea and access to the Black Sea (map, page 103). She reorganized the municipal system. She was, to some degree, a patron of the arts.

On the negative side, she took over all church property, closing monasteries and turning bishops essentially into state employees; it was a cruel wound to a profoundly pious culture. She created more serfs than ever before. And she drove Russia deep into debt for the first time in its history.

Yet Catherine still has secured a place in the historical imagination. We see her in vague dimensions both as an enlightened monarch struggling to bring Western culture to a backward nation and as a passionate woman either coldly manipulative or tragically thwarted in love. But the more I searched, the more she eluded me. Some of her palaces have been left

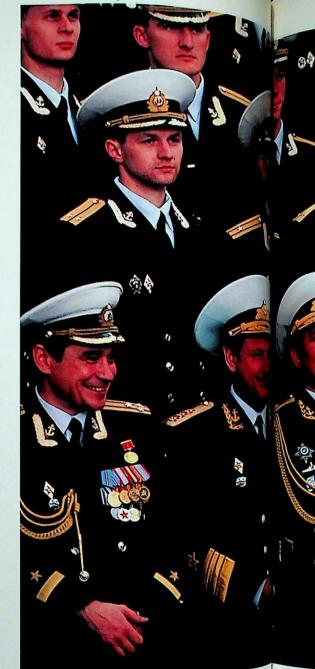
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to dilapidation, some closed to the public. St. Petersburg's Winter Palace is now the Hermitage Museum, and her private apartments no longer exist. Outside the city, at the crumbling mansion Sliding Hill, the long lawn is now empty of the roller coaster she playfully had installed for summer amusement. The royal compound at Peterhof, where Catherine lived off and on during her reign, is Russia's most popular tourist attraction and has all the intimacy one would expect of a place that draws six million visitors a year.

But I eventually discovered that Catherine's world remains, not the world of diamonds and Cossacks but the taut, baffling world of Russia itself. There is the same desire yet revulsion toward Western culture, a craving for reform, an almost agonized yearning for a benevolent autocrat, and desperate social conditions. Since the fall of communism ordinary people endure much the same grinding struggle to survive, political uncertainty, and sense of lack of control over their own lives as did the serfs of Catherine's day. Catherine would immediately recognize this passionate, irrational, titanic nation hungering for happiness even as it savages those who attempt to provide it. Stripped of its splendor, her world remains, in Alexander Solzhenitsyn's phrase, the "accursed Russian reality."

of Anhalt-Zerbst was born in Stettin—now part of Poland—on April 21, 1729.* (In those days Bach was still composing masterpieces, and Benjamin Franklin was writing *Poor Richard's Almanack*.) She was the first child of an obscure German prince connected with the Russian royal family. Not beautiful, and obviously not the longed-for boy, she compensated with quick wit and sheer charm. She was also a tomboy, with a naturally optimistic temperament and inexhaustible energy. Yet she suffered deep early scars; her father was distant and cool, and after two brothers

ERLA ZWINGLE is a former NATIONAL GEOGRAPHIC editor. Her most recent article for us, "Naples Unabashed," appeared last March. Sisse Brimberg, a contributor to the magazine for more than 20 years, has had a lifelong fascination with Catherine the Great.



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Much worse off in every way was the sickly boy, Duke Karl Peter Ulrich of Holstein-Gottorp, to whom she was engaged at age 15. Ugly and eventually disfigured by smallpox, he was also feebleminded, childish, and sadistic. As the grandson of Peter the Great, however, he would become Tsar Peter III of Russia. "My heart predicted nothing agreeable; only ambition sustained me," Catherine wrote in her memoirs. "I had in my heart a strange certainty that one day I should, by

*All dates are based on the Julian calendar.

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my own efforts, become Empress of Russia."

Catherine (whose name was changed when she converted to Russian Orthodoxy) arrived in Russia in the winter of 1744. She hated Moscow; it was too chaotic, too barbaric, too Asiatic. It was Mother Moscow, Orthodoxy's sacred bastion after the fall of Constantinople, a wooden city of narrow, muddy streets and a thousand bell towers whose deafening bells clanged almost continuously.

Moscow still isn't the most ingratiating city. Gray haggard buildings cling to the battered boulevards; the air is scorched with traffic fumes. On the eve of the Russian elections,

At ease in the lap of her admiral grandfather, a girl watches graduation at Dzerzhinsky Naval School. Likewise cozy with the military, Catherine wrested the throne from her husband, Peter III, with the backing of guards regiments. Then she kept the troops under constant surveillance. Soldiers who drunkenly railed against the empress were often sent to Siberia.

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everyone was talking urgently about the need for reform. If there is a constant thread in Russian history—apart from oppression, war, terror—it is reform. "Being reformed is our normal state of being," said Zhanna, a young artist. "We feel like rabbits under experiments all the time," her husband, Slava, added.

Catherine wanted to be admired as a reformer, and she labored tirelessly on important, but unglamorous, issues: the legal code, schools and orphanages, town planning, agriculture. But her idea of reform didn't go too far: She knew that too much change could put her power at risk. She would not have been at all surprised by the fate of Mikhail Gorbachev, former president of the Soviet Union and a champion of reform. Television reports of his campaign for election in 1996 showed him enduring the bottomless rage of his disillusioned countrymen. "Get out, you Judas," screamed one woman. "You sold out our country!" Explaining to a reporter why Gorbachev's countrymen had turned on him, a professor said simply, "Gorbachev decided to change Russia from a feudal state to a civilized one."

Catherine idolized Peter the Great, who ruled from 1682 to 1725 and was the first leader to radically reform Russia. But he had left her plenty to do; behind the facades of baroque palaces the country remained essentially superstitious, uneducated, and conservative. "People were careful not to talk of art or sciences, because they were ignorant about them," she wrote of the Russian court. "One could bet that half the company could not read, and I am not sure whether even a third could write."

The Russia Catherine first visited was still a world of extreme contrasts. Its magnificent palaces were often shoddy inside and reeked of sewage. She wrote, "It is not unusual to see emerging from an enormous courtyard, deep in sludge and horrors of every sort . . . a superbly dressed woman covered in jewels, in a magnificent carriage drawn by six miserable nags in filthy harnesses."

Not everyone was so sensitive to the irony of these contrasts, and undoubtedly many didn't see the point of being westernized. "This tension between Russians and outsiders has been going on for centuries," said Bill

Thomas, a Russia expert I spoke to in Wash. ington, D.C. "They've been inviting foreigners in for centuries. But in the face of Western culture they're incredibly insecure."

This tension still quivers between Russian culture and the West; I felt it often. One morning I was on a Moscow trolley, lurching toward the Kremlin with Svetlana, my interpreter. She was explaining something about politics to me; it may be that she mentioned Stalin. Suddenly a threadbare woman with tarnished red hair pushed up to her. "Do you know Russian?" she snapped.

"Of course," Svetlana replied.

"Well, stop throwing mud on this country!" She began to rant, glaring at me, the Westerner, and Svetlana, the traitor, with pure hatred

But to many Russians, Western culture exerts an irresistible lure. That same evening we went to a political rally and rock concert behind Red Square. It was Russian Independence Day, and Boris Yeltsin had just given a speech. Then a series of rock bands began to play, and 100,000 people began to dance. The early evening sunlight was deep and rich. There were girls with green fingernails and black vinyl shorts, a few choice examples of modern Western culture exuberantly and unabashedly adopted.

Above the crowd was an American Confederate flag being swirled back and forth by a tall, muscular boy. Astonished, I made my way slowly through the crush to ask him why. "It's an old American flag," he explained happily.

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"Yes, I know," I said, intuiting dark references to war and revolution. "But why are you waving it?"

"It's for Elvis," he replied.

ATHERINE WAS MARRIED ON
August 21, 1745, in a sumptuous
ceremony in the Cathedral of Our
Lady of Kazan in St. Petersburg.
She was 16 years old. Later portraits make her
look imposing, but her wedding dress of silvery silk, now in the Kremlin Armory, implies
a slight figure barely five feet tall. That night
her new husband stayed up drinking with his
servants, appearing in her bedroom early the
next morning only to fall asleep.

The following years were hell. Peter took



"Fate is not as blind as one imagines," Catherine wrote, trying to explain how she came to assume the throne of Peter III (below right), grandson of Peter the Great. Historians cite her political instincts and his contempt for Russia. But by overthrowing her husband, who was murdered soon after by her supporters, Catherine put herself in jeopardy. Her claim to succession was their young son, Paul, then as oblivious as this baby in Tauride Garden.



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GEORG CHRISTOPH GROOTH (LEFT) AND PIETRO ANTONIO ROTARI BOTH STATE HERMITAGE MUSEUM, ST. PETERSBURG



Stripped of their gold by the new empress, figures of Atlas adorn the baroque palace of Tsarskoye Selo. Catherine favored the austere neoclastical style that spread across Europe during the Age of Enlightenment;

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it became an emblem of her Western taste. Turning philosophical ideals to political to Political ends, she presented herself as the Roman goddess of wisdom-Minerva Tri Minerva Triumphant—an autocrat ruling for "the good of each and all." a mistress and tormented Catherine with constant insults. Because the volatile Empress Elizabeth, Peter's aunt, limited Catherine's time at court, Catherine spent many hours reading-Tacitus, Montesquieu, and Voltaire, among others. She would also go riding, sometimes for 13 hours a day, on a special saddle that she had converted from the usual decorous sidesaddle to one that allowed her to ride astride. "The more violent this exercise was," she admitted, "the more I loved it."

Intelligent, young, increasingly lonely, and increasingly beautiful, she must have been almost unbearably bored and frustrated. And it must have begun to show. "[Catherine] is romantic, ardent and passionate," wrote the Chevalier d'Eon, a secret agent. "She has a bright glassy hypnotic look like that of a wild animal. . . . She is thoughtful and friendly and yet, when she approaches me I automatically back away. She frightens me."

Catherine wrote about her loneliness and sense of isolation. "Had it been my fate to have a husband whom I could love, I would never have changed towards him," she said. Instead, after seven years of passionless marriage (and facing the urgent need to supply an heir), she succumbed to her infatuation with a handsome court chamberlain, Sergei Saltykov. After two secret miscarriages she bore a son, Paul. It is highly unlikely that her husband was the father, but the child would be acknowledged as Peter's.

Catherine spent much of that time at Peterhof, Peter the Great's favorite palace, 20 miles outside St. Petersburg. The main building is an overwhelming assortment of vast rooms encrusted with gold leaf and cluttered with huge paintings. Outside, heavy golden cupolas crown the corners. Strangely large, they make the palace seem hunched and squat. From the terrace the view cascades with the fall of fountains toward the gray, agitated Gulf of Finland.

But Catherine made her home among the trees below, in the palace called Mon Plaisir. The scale here is more intimate, with the homely Dutch elements Peter the Great found so appealing: black-and-white checked floors, rich wood paneling, enclosed fireplaces covered in blue-and-white tile. The shadowy glades outside, with their frivolous fountains,

overcame the crushing formality of Peterhof

In December 1761, when Catherine was 32 her husband finally became tsar. It was n_0 secret that he intended to make his mistress empress. But Catherine had diligently culti. vated the sympathy of the very groupschurch, nobles, army—that Peter had completely alienated. She was ready to strike,

On June 28, Peter was at Oranienbaum, his estate five miles west of Peterhof. Here, too, there is an immense main palace, but Peter also preferred a smaller place: a secluded two story building where he was prone to have parties that became all-night binges. Today, unlike the theme-park atmosphere of Peterhof, with tour buses in the parking lot and strolling musicians at choice locations, Oranienbaum seems half derelict. The grounds are empty and gone to seed, and the only strollers are the odd family.

Aleksey Orlov, brother of Grigory Orlov, then Catherine's lover, was part of a small group that had been plotting Peter's overthrow. The carefully planned coup was swift, and within hours Catherine had had herself declared empress and secured the city. By the next day Peter had signed the act of abdication. Seven days later, he was dead.

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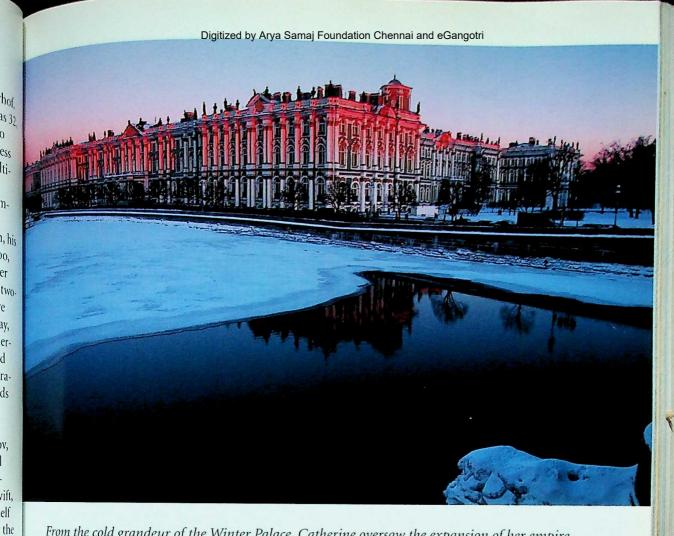
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He died at dinner, under circumstances never satisfactorily explained—Aleksey Orlov, one of the officers guarding him, sent Catherine a hysterical note ("how could we have dared to lay hands on the Emperor? And yet, Majesty, the tragedy happened. He had begun to argue with Prince Fyodor during the meal, and before we could separate them he was no longer!"). Horrified monarchs across Europe, branding her a regicide, predicted a short reign and a terrible end.

ATHERINE began her reign full of great ideas. Her years of reading had filled her with high aspirations. She also had a deep sense of responsibility, an attitude profoundly important to Russians.

"One of the main features of our outlook was faith in the kind tsar," said Sergei Letil, an art historian at the Hermitage Museum "A Russian tsar wasn't just the head of a big government but the head of a big family."



From the cold grandeur of the Winter Palace, Catherine oversaw the expansion of her empire through wars with the Ottoman Empire and seizures of Polish land. To 19th-century revolutionary Alexander Herzen the palace perfectly symbolized the Russian state: "Like a ship floating on the surface, it had no real connection with the inhabitants of the ocean, beyond that of eating them."

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We were walking through rooms full of portraits of Catherine. She gazed out from oil paintings, marble busts, woven tapestries, steel cameos, porcelain figurines. She always had the same expression: noble, kindly, maternal. Visitors to her court were often impressed by her charm—a characteristic not often associated with empresses. She seemed to have some magical combination of regality and what one observer called "a great desire to please."

Russian rulers were usually called Little Father or Little Mother. Catherine assumed this role instinctively. Despite her wide reading of Enlightenment philosophers, with their theories about the natural rights of man, she firmly believed that what Russia needed was a strong hand. She was a tireless worker; her motto was "Useful." She got up early, drank strong black coffee, rubbed her face with an ice cube, and wrote for several hours. Then she would meet with her ministers. Dinner, her main meal of the day, was at 2 p.m. and was usually plain; she had frequent headaches and digestive disorders and wasn't interested in food. Her favorite dish was boiled beef, and she drank wine only if her Scottish doctor prescribed it. After an evening of theater, music, or cardplaying, she went to bed early.

She maintained a spectacular court. "Many of the nobility were almost covered with diamonds... and a diamond-star upon the coat was scarcely a distinction," wrote William Coxe, an English visitor. Yet the splendor was primarily to impress visitors. Catherine preferred the unadorned lifestyle of her childhood. She maintained several private rooms in the Winter Palace where she could relax with her friends. Among ten rules posted at the door: "Pretensions founded on the prerogatives of birth, pride, or other sentiments of a like nature, must also be left at the door," and "Speak with moderation, and not too often, in order to avoid being troublesome to others."

Catherine accomplished some early successes. In 1768, in an effort to quell epidemics of smallpox and to flaunt herself as an advanced thinker, she invited an English physician to inoculate her and her 14-year-old heir against the disease. Her subjects were keen to follow her example. She established a legislative commission to revise the legal code. The

the serfs, which was unprecedented for her day. However, it immediately degenerated into petty squabbling, and after a year she disbanded the group. Its one notable achievement was to vote to exalt Catherine as "the Great."

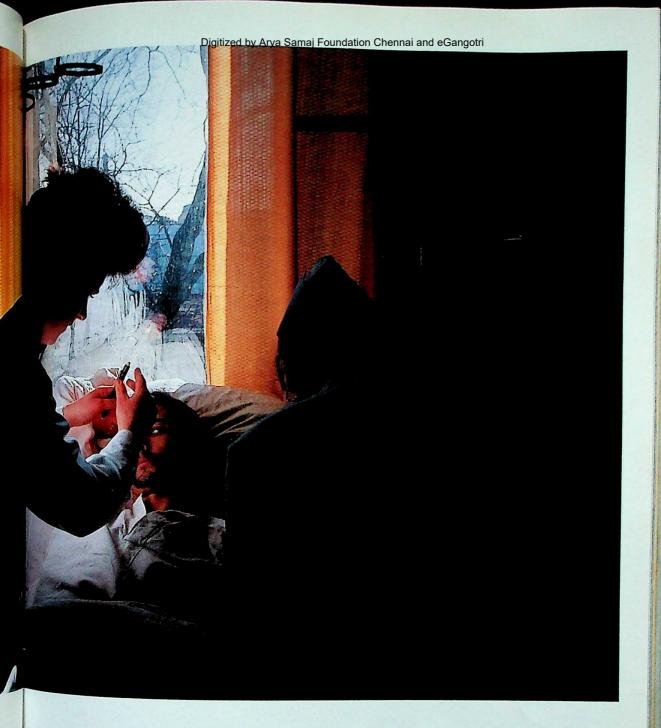
Yet one early decision bore abundant fruit. A year after she became empress, Catherine invited German settlers to homestead Ukraine and the Volga region; Russia needed more people and more agricultural production. She also believed Russia could benefit from German orderliness and industry. Some 20,000 arrived in the first wave of immigration, and

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by the turn of the 20th century almost half a million German-speaking Russians were living along the Volga in what would become the German Autonomous Republic.

During World War II Stalin annulled the republic and exiled its residents to other parts of the U.S.S.R. But today, because of programs sponsored by Russia and Germany, many Germans are returning to form settlements again. Russia has also invited settlers from elsewhere to homestead along the Volga.

Some 15 miles south of the city of Saratov, the village of Bagayevka rises above the broad pewter sweep of the Volga. Newcomers have

Tending to her country's health, like the staff in this military hospital in St. Petersburg, Catherine presented her early inoculation for smallpox as a lesson to the nation, cleaned up Moscow's water supply, and created institutions to care for foundlings and treat venereal disease.

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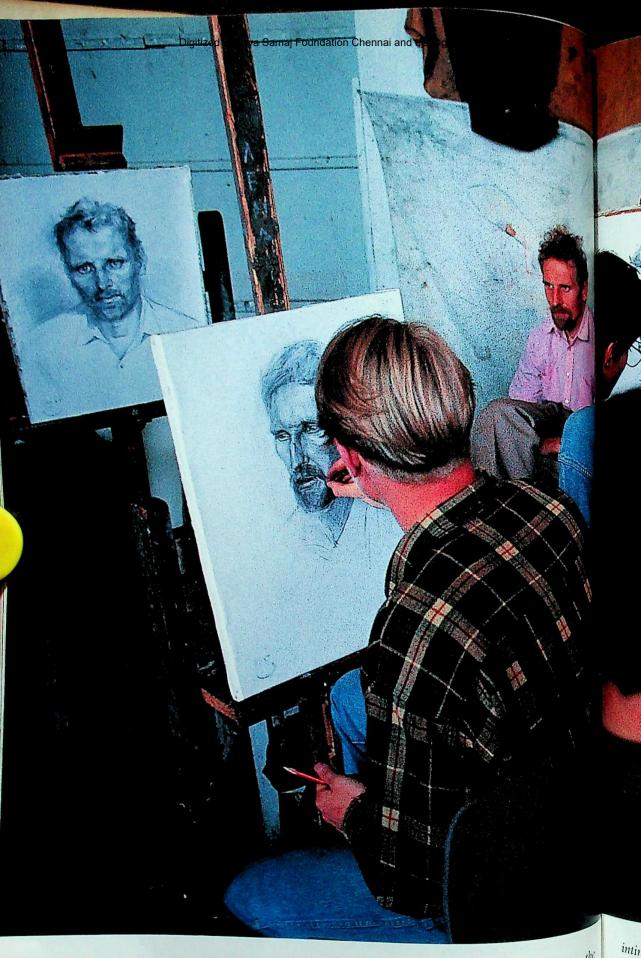
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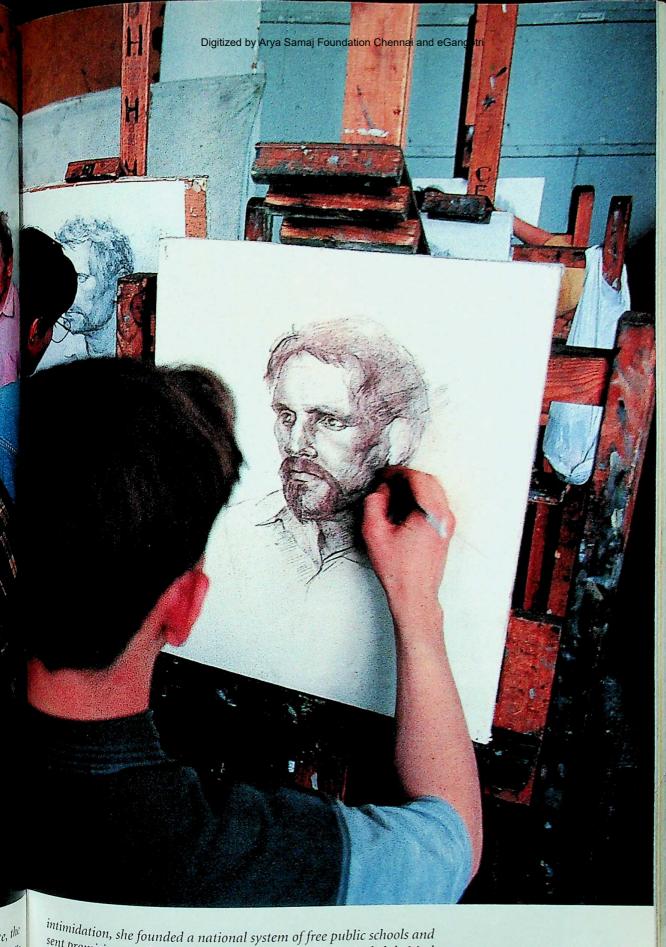
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Candidates compete for admission to St. Petersburg's Repin Institute, the arts academy Catherine expanded in an effort to promote Western learning. Hoping to mold "the perfect citizen" through instruction rather than 150 Jp Public Domain. Curried Research 2011.

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intimidation, she founded a national system of free public schools and sent promising pupils to study abroad. Writes historian Isabel de Madariaga, "Where Peter [the Great] used terror, Catherine used persuasion."

learn than Leaning to kiss the image of Mary, a woman in a Moscow cathedral practices the piety Catherine feigned to win the church's blessing. Patron of writers, not religion, Catherine helped foster Russian literature, a tradition that lives in these poets at a reading in St. Petersburg.

been settling here for the past seven years; temporary trailers house the latest arrivals. The first house on the corner sat surrounded by a glorious vegetable garden. A small blond boy was gathering soft fronds of dill.

His mother came out and introduced herself as Lyubov Sogurenko. "Twenty families living here are pure German," she said. "The others were invited from somewhere else." Lyubov is from Tashkent, Uzbekistan, part Tatar and part Don Cossack, with red hair, a strong body, and a radiant smile illuminated by gold teeth below and silver teeth above. They flashed often.

She proudly showed me around her farm. In soil hauled from the river, she had planted onions, carrots, sunflowers, cabbage, corn, peas, beans, blackberries, strawberries, gooseberries, a small grapevine—even five apple saplings. There were ducks, geese, chickens, and two pigs. She held out her rough palms happily: "I'm weeding all day."

Then she asked me in for tea. The house was cool and plain, with a large television in the living room and also in the kitchen. "My husband is a construction worker," Lyubov said. "But if we had stayed in Tashkent, he'd be unemployed. I worked as a foreman at a shoe factory, but I couldn't support the family by myself. That's why we had to leave. All our money went to the market. But we wanted to feed our children ourselves."

Lyubov poured cup after cup of tea, and we dabbed cream on top of plain cookies. Two clocks ticked, not together. I asked about the upcoming elections. Did she think a woman could make a good ruler of Russia?

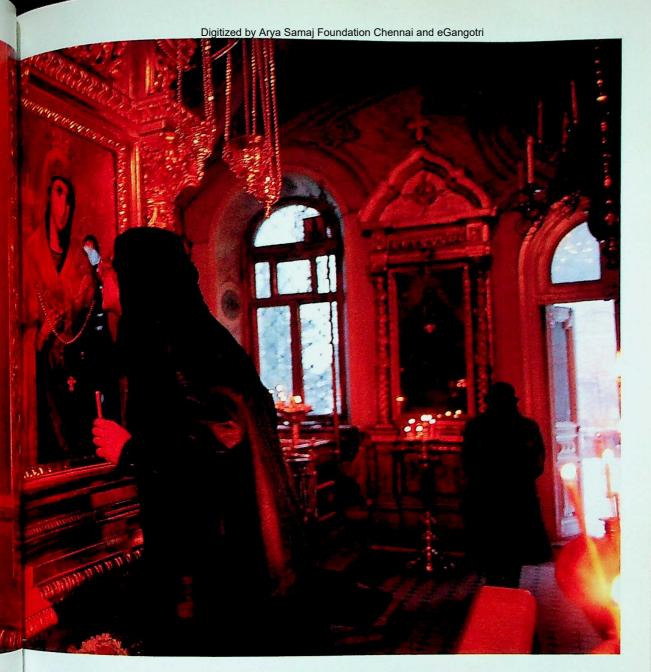
"I think it would be better for the country," she replied. "I feel a woman is more serious. You understand, a woman thinks as a mother; a woman knows the problems of the family, all the pains, more than a man. It seems to me that if a woman were president, she would live



more for the people, the same way she does for her family. There would be the same order as my kitchen garden; everybody would know his place."

This, of course, was also Catherine's concept of the ideal social order. She had dreamed of a nation inhabited by strong, industrious, optimistic people—people like Lyubov. It would seem to be some utopian fantasy if hadn't seen Lyubov's red, callused palms.

Catherine knew that progress would require more than settlers; it would require the support of the nobility. As a woman and a foreigner, she couldn't retain power without them. She gradually extended the powers of the aristocrats while annulling the rights of





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In the shadow of plenty, children beg by a café. Beyond her court's splendor, half of Catherine's subjects lived as serfs and most others as peasants. In the 1770s heavy taxes and mass conscription sparked a rebellion, which was put down with the help of loyal Cossacks like this man's ancestors.

the serfs. By 1796, the year she died, Russia contained more than nine million male serfs (females weren't counted), more than half the male population. They lived at the mercy of their masters, on whom there were no legal or social constraints. "What is the use of the nobility being free," an elderly noblewoman exclaims in a play of the period, "if we are not free to beat our serfs?" The fields were ripe for revolution.

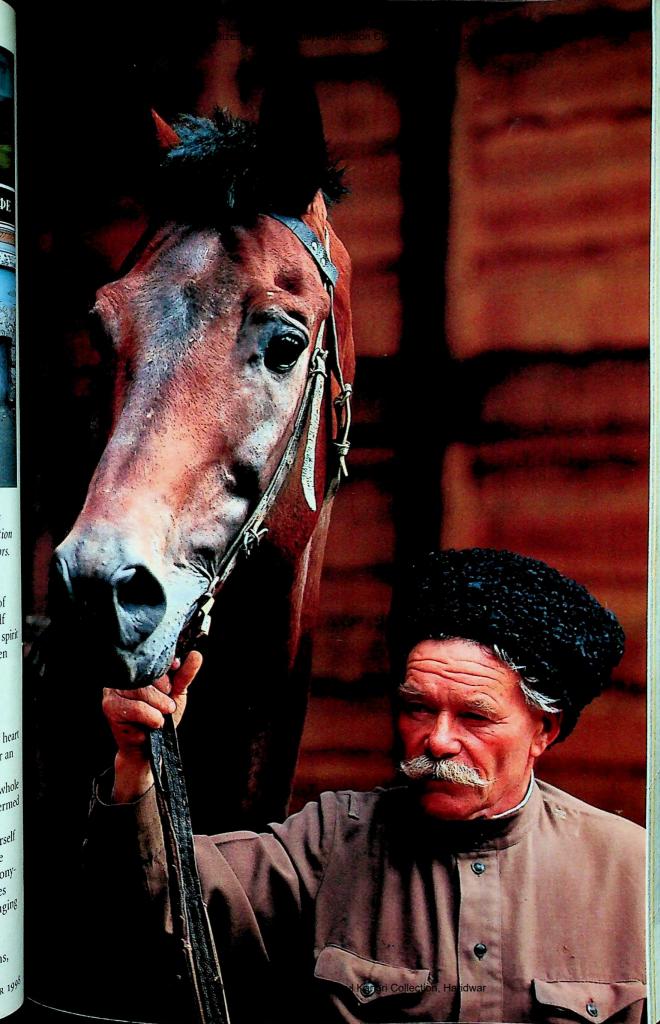
In 1773 an obscure Cossack named Yemelyan Pugachov rose up. For an entire year his followers swept across Russia capturing cities, pillaging estates, and murdering nobles. They were preparing to march on Moscow when Catherine's army finally stopped them; Pugachov was executed. But Catherine was never the same. More concerned by the impression this turmoil would make abroad than in addressing the injustices that had caused it, she explained it to Voltaire by saying that Pugachov came from a part of Russia that was

"inhabited by all the good-for-nothings of whom Russia has thought fit to rid herself over the past 40 years, rather in the same spirit in which the American Colonies have been populated." She abandoned any further attempts at serious reform.

WISFORTUNE," Catherine wrote frankly, "is that my heart cannot be happy, even for an hour, without love."

This is the clearest explanation of the whole tortured subject of what were officially terned her "favorites." Her love letters show an unembarrassed eagerness to abandon herself completely and to believe her lovers to be absolute ideals. Far from being quick, anonymous encounters, these affairs—estimates vary from 12 to 20—were fairly long, ranging from one to twelve years.

Many European rulers were quick to defame her, primarily for political reasons,



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and sexual slander was the easiest weapon at hand. One of the kindest insults was "Messalina of the North," after Roman Emperor Claudius's insatiable wife. Ugly myths took root: that her lovers were chosen for her and that her lady-in-waiting "auditioned" them.

Wanting a companion as much as a romance, Catherine made an effort to educate at least a few of her lovers in political matters. Some were relative nonentities; others—such as Grigory Orlov (the dashing guards officer who helped put her on the throne), Stanislaw Poniatowski (she later made him king of Poland and broke his heart), and Alexander Lanskoi—were strong individuals who deserved her devotion. Her grief at Lanskoi's

Reconstructing Russia, Catherine encouraged the cultivation of new crops such as potatoes, now common in city markets. In her capital, still cluttered with engineering projects (below left), she inspired a saying: "When she came [it] was of wood, when she left it was of stone."

sudden death from diphtheria was genuine: "My happiness is gone," she wrote to a friend. "I have thought of dying myself. . . . My room which until now was so pleasant has become an empty cavern into which I drag myself like a ghost . . . I cannot see anybody without being choked by sobs. I cannot sleep, nor eat. Reading bores me and writing exhausts me."

The one lover who left a lasting mark on her as well as on Russia was the charismatic Grigory Potemkin. He is well known as the creator of the so-called Potemkin villageswhich his enemies claimed were constructed only of false fronts, to give the impression of a village where there wasn't one in order to impress Catherine on her tour of the Crimea in 1787. But he was also an effective reformer of the army and an astute statesman who negotiated the annexation of the Crimea, which he spent years developing—founding cities and universities, building roads, opening shipyards, and attracting settlers. Although they were lovers for only two years, he remained one of her closest confidants and labored tirelessly on her behalf.

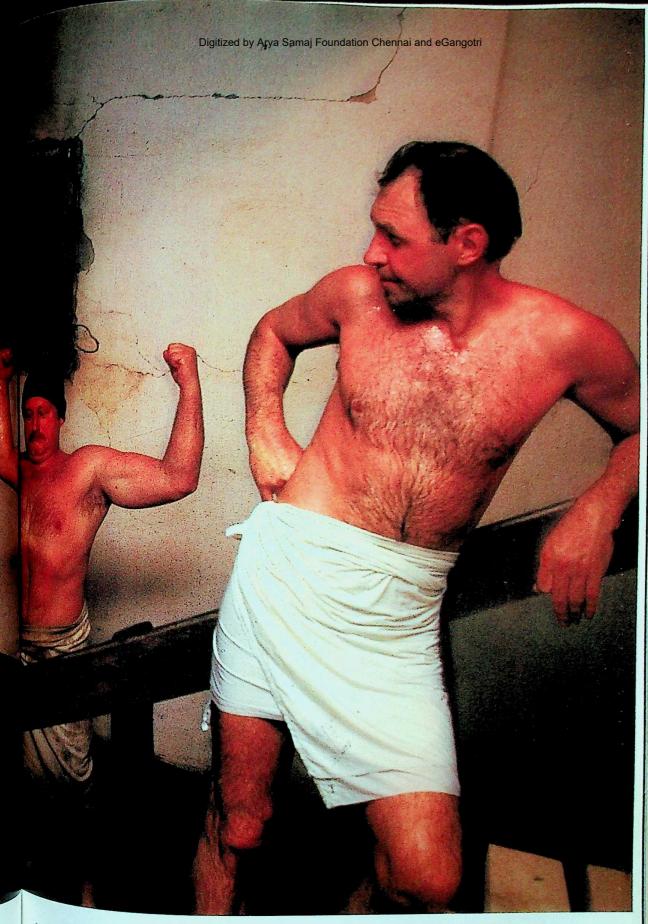
The last year of Catherine's life was 1796. She had once sworn to live to 80, but now, at 67, she could sense that she wouldn't make it. Heavy and bloated, she felt the even heavier weight of accumulated disappointments. Her daughter, Anna, had died as a baby; another son, Aleksey, lived away from court. Her heir, Paul, openly loathed her, and his personality was alarmingly like his supposed father'sunstable, extreme, and obsessed with the military. She intended to make her grandson Alexander her legal heir instead.

In September came a crushing blow: Young King Gustavus of Sweden publicly broke his engagement to her granddaughter Alexandra. The rebuff was insupportable; Catherine may have suffered a slight stroke. One evening she saw a shooting star and told her companion,



Mocking himself, a sculptor displays his physique in an old bathhouse closed by the government but visited weekly by a small group of artisals. Adding to the gossip of the day, Catherine rendezvoused in such a steal of the such as the such a steal of the such as the suc

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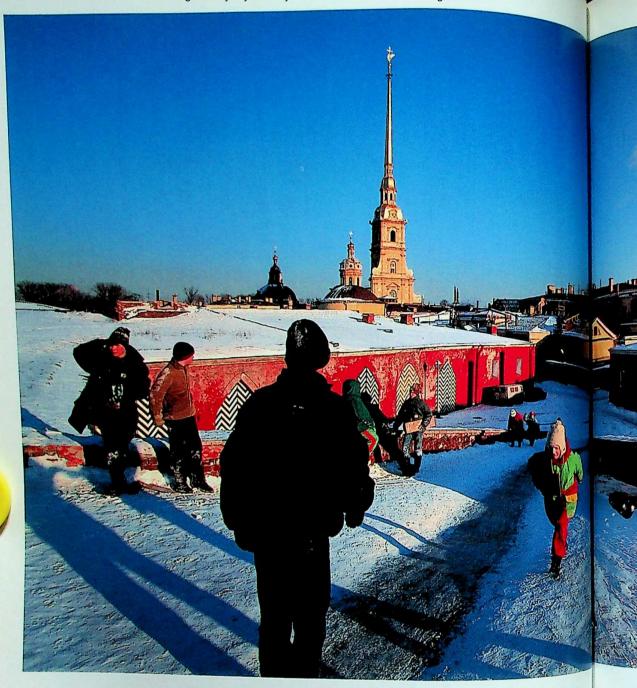


Setting with the statesman Grigory Potemkin, fifth of her many lovers.

Though Politically powerful, Catherine was emotionally vulnerable. "She sometimes felt achingly lonesome," writes historian John T. Alexander.

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isans team)



After a quarter century of rule Catherine, in her late 50s (above right), presided over a vaster, stronger, and more prosperous Russia. Laid to rest at age 67 in St. Peter and St. Paul Cathedral within an island fortress in St. Petersburg (above), the empress was largely ignored by the Soviets but is celebrated today by a new generation embracing Western ideas.

"That is an omen of my death."

On the morning of November 5 she followed her usual routine in her private apartments within the Winter Palace in St. Petersburg. Outside, snow had already covered the impressive palaces lining Nevsky Prospekt the city's main boulevard. Then she went into her bathroom. Servants found her slumped on the floor, the victim of a massive stroke.

She lingered until 9:45 the next evening. Paul knew that Catherine intended to name her grandson her heir; immediately after her death Paul sealed her study, and an act of succession was never found. Later he had

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Peter's body exhumed and laid in state next to Catherine's in the Hall of Pillars. Above their heads he placed the grotesque inscription "Divided in Life, United in Death." The funeral cortege crossed the frozen Neva to the Cathedral of St. Peter and St. Paul, where they were buried side by side.

I stood in the cathedral on a chilly June morning. Pale light was pouring through the tall windows, and the trees thrashed in the wind. A golden iconostasis stood in front of the apse. There were empty holes where paintings were supposed to be. It looked like an unused stage set. There were no candles, no



MIKHAII SHIBANOV, STATE HERMITAGE MUSEUM

lingering perfume of incense, nothing to suggest the elaborate Orthodox liturgy. Catherine's tomb was like many of the others: a plain white marble oblong with her name and her dates in brass lettering.

But what memorial would I have wanted to see? A statue of her, as she loved to be portrayed, as the benevolent lawgiver? Her laws benefited few and required financing that burdened the country with a 200-million-ruble debt. Enlightened monarch? "The ideas of the century," one critic commented, "passed over her like a beam of light on the surface of a pool, without warming the depths below."

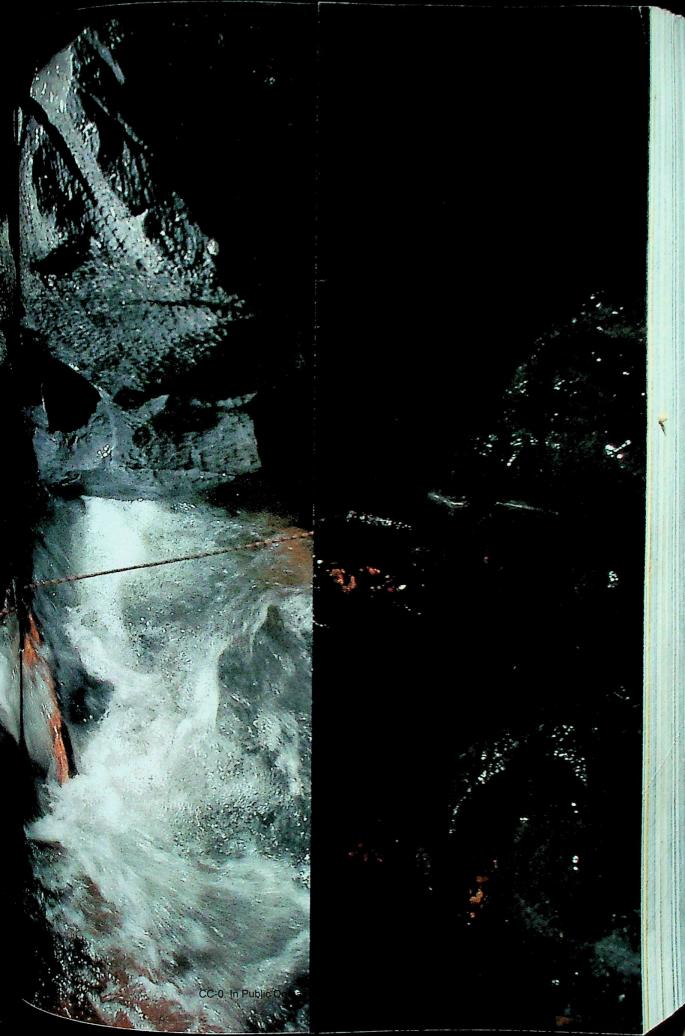
And yet, amid the failures, there remains the woman herself. A woman who could entrance visitors and win the adoration of her servants; a woman who loved to laugh and who wouldn't let certain plays be performed without first tacking on a happy ending.

I couldn't think large thoughts in front of such a small tomb. Here and there were a few offerings, some lilacs or carnations in plastic vases. A few days earlier, at one of her estates, I had picked a cream-colored wild rose. I couldn't resist its scent: powerful yet delicate, complicated, voluptuous. I realized now I should have brought it here.

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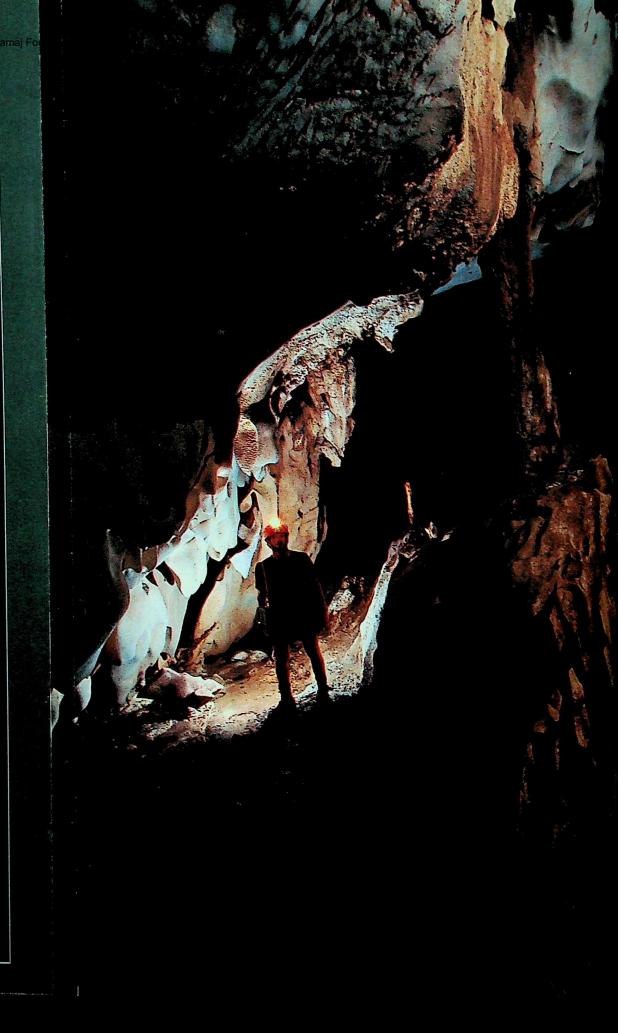




Fighting his way past a waterfall, John Lane pulls out of a cave in Gunung Buda, or White Mountain, in Borneo's Sarawak rain forest. His team of 24 cavers and scientists braved poisonous snakes, biting insects, and raging rivers (preceding pages) to map—and save—the region's natural riches.

Searching the Depths of Borneo's White Mountain

By DONOVAN WEBSTER Photographs by STEPHEN ALVAREZ



If you fell on one, you'd impale yourself," says caver Trent Atwood, foreground, of razor-edged limestone pinnacles in Tardis Cave. Such spires take millions of years to form as water dissolves the limestone.

T RISES LIKE A DAGGER above one of the oldest rain forests on Earth, a peak of pale limestone cloaked by vine-throttled trees. Called Gunung Buda—White Mountain—the 3,161-foot formation deep in the jungles of Borneo holds a secret within. Rainwater has been trickling through the rock for eons, dissolving the peak's interior into sprawling systems of voluptuous grottoes and uncharted pits. And somewhere in one of these caverns, breathing air reeking of bat guano, coated in slick mud, I sit alone and lost.

Behind me water drips from the ceiling into an urn-shaped pool. Ahead my helmet's lamp cuts the blackness. When I switch the light off to conserve battery power, there is only the clammy dark, the chuckle of slow-moving water, and the occasional *cheer-reep* of a bat on a flyby. If I flip the light back on, clusters of bright green gems—the multiple eyes of hand-size, poisonous huntsman spiders—duck behind rock overhangs and the jagged rubble floor.

I'm sitting here because after hours of following expedition co-leader Todd Burks, photographer Stephen Alvarez, and Stephen's assistant Trent Atwood as they scrambled and crawled through the vertical rifts and giant oval caves of this mountain, I became so exhausted that further exploration was dangerous. So after a break to recharge my strength, Atwood consented to return above ground with me.

But now, deep inside this honeycomb of a mountain, we're disoriented. Each passage looks like the others. When we come to a ganglia of connecting passages, any option we choose makes a quarter-mile loop back here. So as Atwood continues his predictable laps ("I know we're missing one turn somewhere," he says at each circuit), I wait by this water hole, the only place that Burks and Alvarez must pass on their way toward sunshine.

I should have expected this. After all, on maps of Sarawak—as this Malaysian state on the island of Borneo is known—legends bear these cautions: RELIEF DATA INCOMPLETE ... GENERALLY FOREST COVERED ... MAY BE

DONOVAN WEBSTER has slogged through the Gobi and Venezuela's Orinoco River wilderness for the GEOGRAPHIC but says this was his most demanding assignment. A native of Sewanee, Tennessee, STEPHEN ALVAREZ has explored caves since he was a boy.

SIGNIFICANT POSITIONAL DISCREPANCIES DETAIL. So here I am, a 37-year-old father of two—a man with a future to consider scared and stranded beneath the ground at the edge of an uncharted jungle, where maps actually apologize for being unreliable.

Yet even as Atwood and I bumbled in circle with each new step a once hidden work opened in any direction we looked, which one of the lures of this offbeat adventure. I fin my lamp back on, aiming its beam at the celling. Gooey-looking white drips of deposite limestone hang suspended in open air. Beyond them a dark and inaccessible shaft rises up through the cave's roof like a ramp extending toward eternity.

When Atwood reappears, we sit together in the darkness. Suddenly in the passage behind us I hear Burks and Alvarez returning. Their headlamps

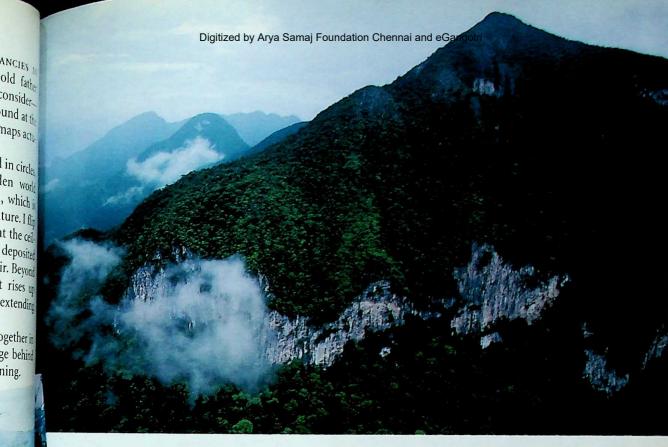


slash the gloom

with friendly bouncing beams
"You lost?" Todd Burks asks when he sees us
"Yeah," I say.

"Well, I know the way out," Burks says, be smile caked with mud. "Let's go."

We've come to Borneo on a mission: To hely save Gunung Buda from the chain saw and jackhammer. Encircled by logging and ministrone concerns, the mountain's heights are outsit the reach of these industries, which stripped much of Malaysia's old-growth feests. Malaysian government officials have recognized Buda's situation and want to play the mountain and its surrounding rain force.



Bringing Buda to light

With equipment for six weeks, the American-led team assembled in Borneo in October 1996. Their mission: To probe 3,161-foot Gunung Buda (above) for virgin caves

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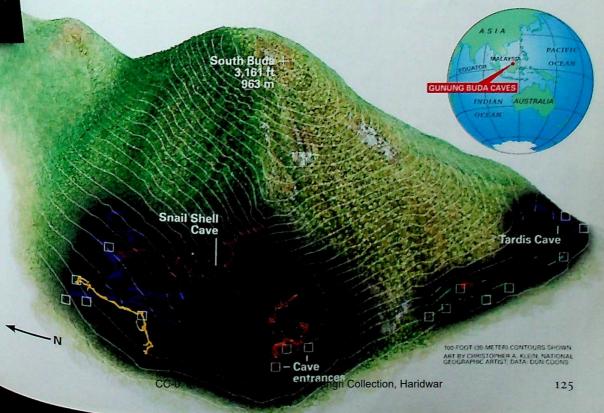
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with plant and animal life diverse enough to prove it worthy of protection from logging and mining. Then, to persuade Malaysian authorities to declare the region a national park.

Old logging roads (left) cut paths to white limestone cliffs, entry point to a network of caves carved by time and running water. By journey's end the group had mapped five miles of virtually unexplored cave passages.



in a protected management zone—but they need an inventory of the area's treasures to support their plan.

"Whether the government sets the area aside this year, in five years, or never depends on what's discovered out there," says Dave Gill, a Sarawak forestry department representative.

O ADD MORE INFORMATION to the crucial data accumulated by a previous expedition, our team of 24 cavers, explorers, cartographers, biologists, and photographers will spend November and early December mapping cave systems while piecing together a broad, multidisciplinary survey of life on and beneath the mountain's surface. Our herpetologist will collect amphibians, fish, lizards, and snakes, some poisonous. One helpful expedition member will carry an extremely dangerous snake called a banded krait to camp in his fanny pack, prompting our snake expert to write on the galley announcement board: "PLEASE, NO POISONOUS SNAKES IN CAMP!"

Our entomologists will collect all freakish manner of insects. Our biologist will catalog everything from cavedwelling spiders to albino crabs to millipedes. A hydrologic team will introduce nontoxic dyes into the cave's subterranean rivers to see where they exit the mountain, providing a better idea of how water travels through Buda. Our archaeologist will photograph and document sites of human habitation, whether ancient or recent.

All these data, plus maps of each cave we discover, will be entered into our laptop computers, with each

of us taking turns at the keyboards late into the night. Everyone knows the clock is ticking.

"We're fighting against time," John Lane, co-leader of the expedition, tells me early in the trip. "This area is covered with trees that would make valuable lumber. And the limestone of the mountain could be used to make a lot of concrete."

Doing good science is our top priority, but in the jungle everything takes a backseat to

survival. After only a week in Borneo our Car resembles nothing so much as a pirate ville As the first glow of dawn lights the sky, team rouses in an open-sided, tarp-roof stru ture, whose raised floor keeps us out of the mud and discourages snakes from become bedfellows. Tired groans mix with the high pitched whistles and shrieks of the jungle dirty, unshaven cavers push aside mosque netting and pull on slowly rotting boots at pants that, last night, were hung on rafter to partly dry in the steamy air. Outside, the mist swirls through the rain forest, when layers of overstory and shrubby underthide make it impossible to see farther than 50 fee Sweat bees are swarming over our skin clothes. And in the jungle, fat, black leeden wait to attach themselves to our ankles and armpits.

In the constant humidity of the rain force the threat of fungus and infection means the all cuts, scratches, and bites must be cleaned two or three times a day or softball-size inflammations will blossom overnight. Nobel



One false step and camp manager Paris Wan (right) could be left dangling over a ten-story drop into a vertical passage called Croc Pot. The name was inspired by local guides, who believed that nearby tracks meant crocodies lurked in the pool below.

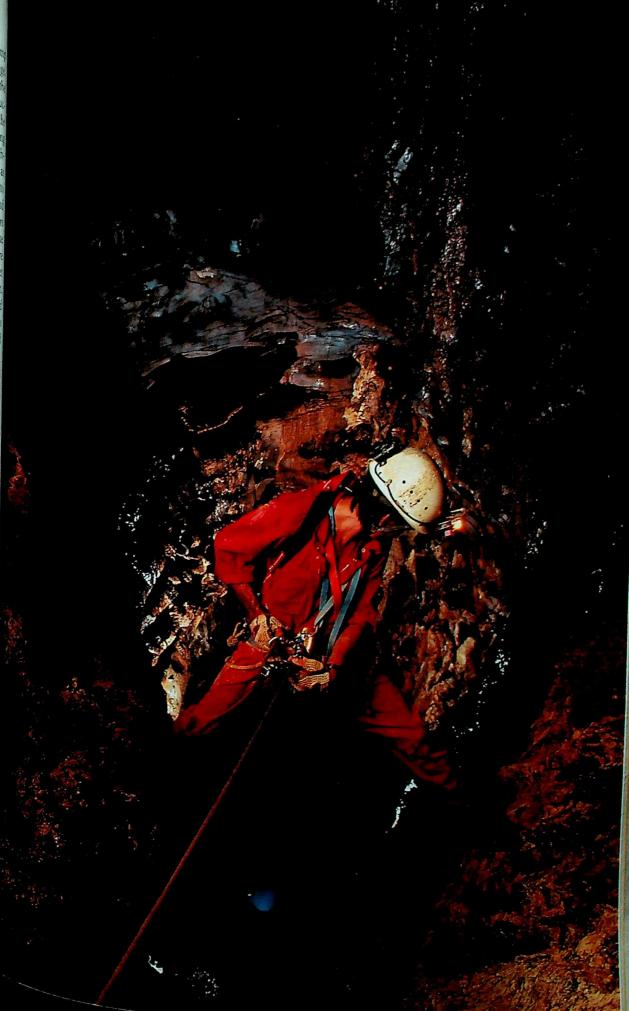
Squeezing through a muddy hole, caver Brad Stewart (above) sizes up one end of Snail Shell Cave. At 1,546 feet from top to bottom, this cave system has one of the greatest vertical changes of any in Borneo.

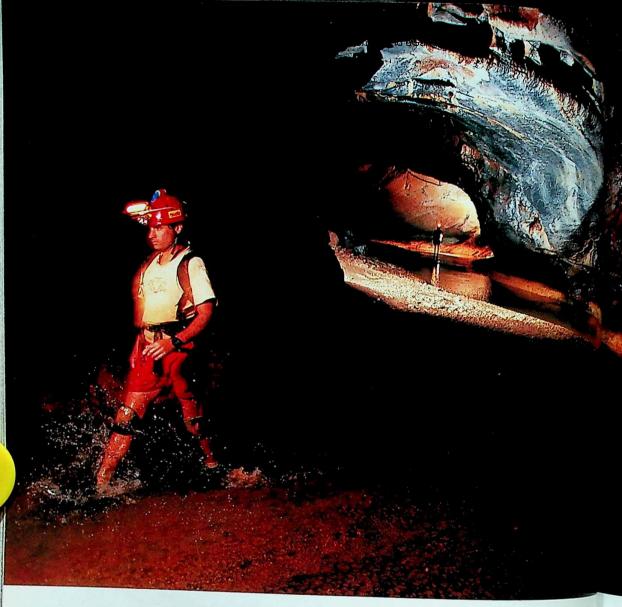
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knows this better than Brad Stewart, who was slow to tend a gash on his shin and awakened to find his ankle and foot bloated to the size of a grapefruit.

By six o'clock in the morning the kitchen has hot water and coffee, and the cavers are already carrying their plastic carbide-lamp helmets—like those that coal miners wear—as they crowd around the rough dining tables for a briefing by John Lane. Lane looks more like a banker than the leader of a caving expedition. He grew up in the suburbs of San Francisco, exploring caves across the West as soon as he left home.

By the 1980s, still in his 20s, he had explored cave systems in the United States, Belize, and Guatemala. Then in the early 1990s he read about several recent British expeditions to Sarawak. The Brits had discovered some of the world's most spectacular caverns, including the monstrous Sarawak Chamber, which at

40.2 acres with a 260-foot-high ceiling is near as large as the Louisiana Superdome.

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"I knew I had to go," Lane says.

In 1995 Lane and caver George Prest let their own expedition to Gunung Buda. With only eight weeks in the field, their 18-member team discovered 14 new caves and mapped is miles of passages.

As he finishes his coffee, Lane gives of assignments. Some cavers will explore, other map, and still others fetch and purify water Cavers are some of the most enthusiastic (and least heralded) athletes on Earth, but even the occasionally need to be bullied.

"We're on an expedition," Lane tells the knocking his fist against a table for emphase "Which means you sacrifice your body don't sleep or eat much. You push yourse to your limits for one month—then you shome and rest. This kind of sacrifice may be always be fun. But if you do it right, a month

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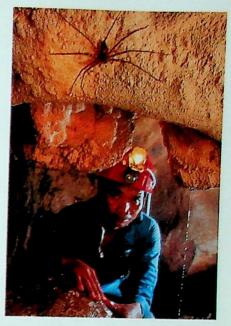
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Following the flow, Brad Stewart explores an underground river in Snail Shell Cave (left). This terrain can quickly turn dangerous. Heavy rain can raise water levels five feet in one hour, making impassable the section where cartographer Chris Andrews and guide Thambi Epoi take measurements (below).

A large huntsman spider poses a lesser threat to Epoi. Says one caver, "Their bite is bad, but nobody has died from one."





struggle can yield results you'll be proud of for the rest of your life."

o discover Buda's secrets, we have to claw up steep vine-choked slopes over sharply eroded, boot-eating limestone. Most cave entrances are at least a hundred feet up the slope

One afternoon I'm exploring a cave system called Snail Shell. A spiral of ramps and passages that rise and splay beneath the mountain's southwest side, Snail Shell roils inside the mountain for more than 1,540 vertical feet, with nearly seven miles of passages. I'm crawling through mud on my hands and knees in a 445-degree angle

"Hey, Moe! Look out!" Todd Burks says from somewhere behind me, doing his best helmet collides with a pencil-size stalactite

suspended from the ceiling. Shards of gritty limestone rain down the back of my neck and arms.

The going is slow. In this mud you've got to push forward a few careful inches at a time or risk sliding back, out of control, cutting yourself badly as you shear off dozens of stalagmites. My helmet sits just low enough on my brow that once in a while I don't see a hanging formation and knock it loose anyway.

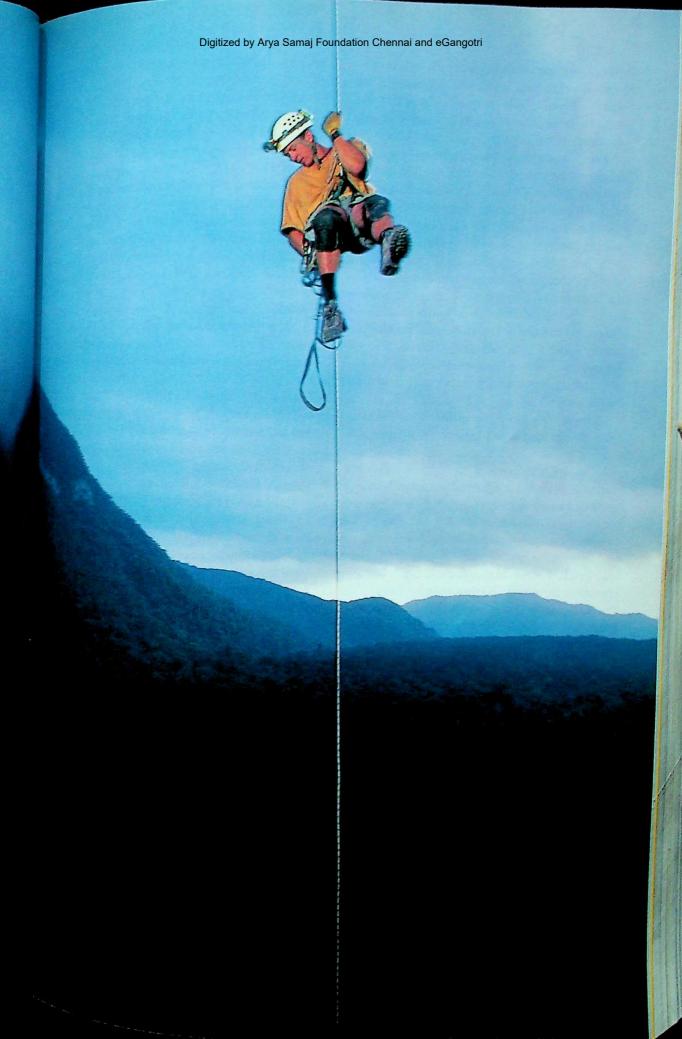
A bat flits past my right ear. I pause, my headlamp flickering against the low rock ceiling. I'm beginning to regret this whole experience. After 60 or so yards, however, the roof of the cave lifts again, and I can rise off my belly and walk.

The passage tilts relentlessly uphill, and the floor remains slick. I fall, scraping my shin on a limestone blade. Ahead, the passage flattens for ten yards, then opens into darkness. Along one wall, a narrow mud-covered shelf—

Digitized by Arya Samaj Foundation Chennai and eGangotri

Big sky and deep horizons break the cave routine for Todd Burks, who rappels 300 feet down to the forest floor after a dramatic mountainside survey.

Surviving a potentially deadly attack of ground hornets on his way up, Burks hoped to investigate two virgin caves he had spotted on an expedition in 1995. After a two-day, muscle-wrenching climb, he discovered that the caves extended a mere 20 yards into the mountain.



perhaps six inches wide and 15 feet long—hangs above a dark pit. It's the only way across. I have no choice. Grabbing stalagmites that rise above the shelf, I begin along its narrow length, belly against the wall.

"Don't look down," Burks advises.

I take another step sideways. The lugs on my boots are caked with mud. I feel the slickness of mud on mud, my footing unsteady. One step. Another. I reach to grab the next stalagmite and my foot slides free—I'm falling.

"Whoa!" Burks and I say simultaneously.

I slap both hands across the stalagmite—it's the size of a Coke bottle—and slam against the cave's wall. This is like a bad dream. In the darkness, my heart pounding, I'm hanging above a black pit. My feet drift in the air for what seems an eternity. I'm simply there, suspended, my breath booming in and out, wavering with adrenaline.

"Slow, man, slow," Burks coaches. "You'll be OK, just pull yourself back up."

Finally, after deciding the stalagmite won't give way, I pull myself up gently—a quick movement could snap the limestone—set my feet back onto the shelf, and slowly lower my weight onto it.

Shivering with fear, I take a few steps onto a broad floor beyond the pit. My knees are shaking. Behind me Burks, a veteran caver, blithely traverses the shelf. The walking is easier now, the floor eroded into wet and muddy channels, between which rise strips of solid rock. A hundred yards later the passage stops short at a cliff, where a sheer-walled shaft rises up into the darkness with no footholds or handholds. Dead end.

Our headlamps reveal only bits of the cliff, illuminating the rock in small, dim patches, but there is clearly no way to go forward. That's how it often turns out for cave explorers. Having struggled so hard to push deep into the ground, we've been defeated by something as elementary as a 20-foot wall and the pull of gravity. We turn around and go back.

ven as the expedition's hard-core cavers continue to probe new passages, other team members are busy above ground cataloging the region's diverse wildlife. As night falls on the logging road a quarter mile outside camp, Nathan Schiff, an entomologist on field-study hiatus from his job with

the U.S. Department of Agriculture, calls in thick cloud of bugs.

To accomplish this, he and another expedition entomologist, Steve Heydon, use a technique called black lighting. Hanging a large white sheet vertically above the ground, they positioned a mercury-vapor lamp and a ultraviolet bulb behind it, illuminating the arguments with a ghostly blue glow.

"It brings them in from all over," says Dr. Schiff. "All different kinds of species are attracted. They can't keep away. When they land on the sheet, we can choose the taxa we want to collect. It's easy."

Beyond us the night is alive with the mating calls of frogs and katydids. Schiff, a store 38-year-old with boundless enthusiasm, can contain his admiration for every leaf and been in the jungle.

"This may be the oldest forest on Earth, 100 to 150 million years," he says, lifting a hand and gazing up to where the treetops meet a rate starry sky. "In all that time, the forest has stayed pretty much the same."

True to Schiff's advertisement, insects have started homing in on the black light sheet from every angle. The largest of them are brown-and-white uraniid moths. Each as big as a pie plate, they dive toward the glowing sheet along vectored corkscrew paths.

A few feet off the ground, giant flying beetler motor toward the sheet like dark fastballs out of the black night. "Those are mostly females scarabs," Schiff says. "The males are really remarkable as specimens. They have three large horns on their head."

Soon the sheet is plastered with insects, and Schiff and Heydon go to work, plucking specimens and placing them inside their collecting bottles, which are lined with a paper town saturated in ethyl acetate. The jars humaned dispatch the animals, allowing the scientist to take field notes on them the following afternoon before packing them away for shipment to their offices—Schiff in Albany, California, Heydon at the University of California at Davis.

"I'm sure we'll collect hundreds of new species out here this year alone," Schiff says, hands moving quickly as he plucks new but "It will take 20 years to identify them all."

He shrugs, then turns and takes in the cap opy of trees again. All night long, insects

fall like raindrops toward his trap, their long trip to the United States just beginning.

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NAKE EXPERT Ralph Cutter has been scooping up reptiles both in the caves and in the forest. The most tantalizing for him are four-foot, gray-and-yellow-striped cave racers that dangle just out of reach on stalactites. From these seemingly impossible perches, they wait to snatch a cave swiftlet or bat as it flies past. So far he has been unable to collect the elusive snakes.

He's had better luck in the jungle. On a blisteringly sunny morning I follow Cutter along an overgrown path about three miles from camp. He pushes a steel hook ahead of him. The hook, at the end of a long golf-club-style shaft, is all that stands between him and a venomous snakebite. If he comes upon a cobra or krait, he can lift the snake and examine it from a safe distance.

"We have to assume every snake is poisonous," he says, "because with many of the species we just don't know."

As Cutter creeps forward, he tells me about one species of cobra in Borneo that spits

venom into an enemy's eyes from as far as five feet away. The venom shocks and momentarily blinds prey—leaving it susceptible to fanged attack. "That's why jungle guides wear shiny pendants around their necks in the bush," he says. "If they get a spitter, the cobra thinks the shiny jewelry is an eye—and it spits venom at the pendant instead of into their eyes."

I look at Cutter. He has a pendant dangling across his chest.

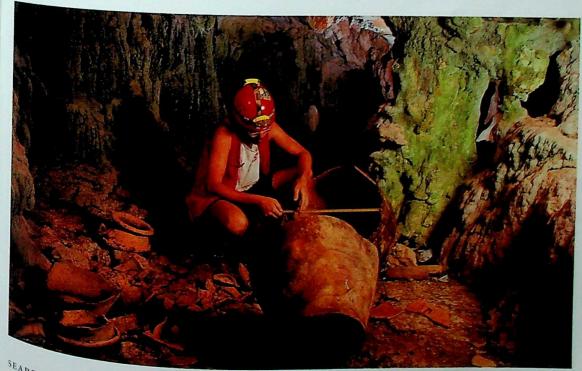
"Don't worry," Cutter says. "We're moving slow. We'll be fine."

Suddenly a small tan-colored snake snaps to consciousness in a rainwater pool ahead of us. It begins to zip beneath a downed tree.

"Snake!" Cutter shouts. The animal disappears beneath the log, and Cutter tosses aside his hook, tumbling into the puddle on his knees, going after the reptile with his bare hands and grasping it by the tail. As his hand follows the animal into a muddy concavity under the tree, he uses his fingers to follow its body toward the head. Cutter finds himself in a standoff, ultimately having to release his grip.

Standing up to strip the mud off his legs with an open hand, Cutter launches a hangdog

Cracked pottery and bits of human bones litter the floor of Urn Cave, a weathered 200-year-old burial site probably for the indigenous Tabun. After a body was allowed to decompose in the forest, the bones were placed in an urn and carried up the mountain to the sacred resting-place.



SEARCHING THE DEPTHS OF BORNEO'S WHITE MOUNTAIN

grin. "Man, am I stupid," he says, shaking his shaggy head. "Here I am, talking on and on about treating every snake like it's poisonous. Then I get excited and go after the first one I see with my bare hands!"

end in early December, Lane, Burks, and the others will have collected a mountain of evidence to support protected status for Gunung Buda. They'll discover three new cave systems, mapping five miles of new passages. They'll capture hundreds of species of wasps, beetles, ants, spiders. And later, citing this team's findings as well as those of Lane and Prest's 1995 survey and the results of a Prest-led expedition in 1997, James Wong, Minister of Environment and Housing, will recommend that the government set aside the Gunung Buda region as a national park.

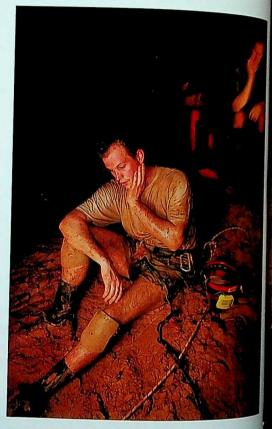
But this morning, a week before our team is due to go home, Todd Burks has only one thing on his mind. Three hundred feet above the jungle a pair of virgin caves stare out into the darkness from Buda's ghostly face. Yesterday Burks climbed more than halfway up the sheer cliff before reaching exhaustion. Today he plans to finish the climb and explore the caves.

As he ascends, he places metal anchors for safety ropes into cracks in the rock. In some places he loops a length of nylon webbing around a limestone pinnacle for protection. In others he uses tiny hooks that grasp smaller blades of limestone, the wall's only features, hoping they will hold him if he takes a long fall.

By early afternoon, after being baked for hours by the sun, Burks watches rainy season clouds start to group and drizzle. By four o'clock a storm is raging. But under the cliff overhang, he gets none of its relieving moisture. An hour later, ten feet below the caves, he hears Chris Andrews shouting. Andrews, a usually reserved Coloradan, is whooping. "You're almost there. It's right above you!" he screams to Burks, whose view is blocked by the overhang. With one more pull, Burks is inside.

As the reds and oranges of the late day sun pour inside the caves, Burks can instantly see that they go nowhere. At one time, millions of years ago, they may have been a subterranean river's oxbow. Now, in the glowing rays of sunset, he figures the caves snake inside the mountain for only about 20 yards.

"I had to press my entire body against mud-caked walls just to get enough traction to take a step," says John Lane, who hit a dead end in Snail Shell after advancing only 120 feet in five hours. In Tardis Cave (right), Need Messler eyes a more tempting passage. Because of the efforts of cave explorers, plans are under way to grant protected status to Gunung Buda and its hidden treasures.



Exhausted and momentarily discouraged. Burks sits, cross-legged and spent, on the lip of the cave mouth. Below him, in the dense jungle, it is already dark. But here on the lime stone face of Gunung Buda he has a privale viewing of the rich, blood-red sky of the Sara wak jungle evening.

Even though Burks is disappointed that these caves lead nowhere, the idea that he may be the first human ever inside them is supremely satisfying. True to John Lane's per talk, his efforts—like those of the others have earned him something he can be proud of for the rest of his life. As he stares at the crimson light falling across the quilt of this ancient, deep green rain forest that he struggled to preserve, Todd Burks grins private smile of victory.

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HARRY BURTON O NEW YORK THE

■ FROM THE GEOGRAPHIC ARCHIVES

Carried Away by Egyptology

"Suddenly and without warning some wondrous treasure would be brought forth in its rough but easy-riding ambulance," wrote staffer Maynard Owen Williams, describing the removal of artifacts from Tutankhamun's tomb in our May 1923 issue. British archaeologist Howard Carter (in coat, tie, and white shoes) had discovered the pharaoh's burial trove in Egypt's Valley of the Kings the previous November, and Williams was among the first journalists to enter the tomb. He wrote that fellow correspondents whispered while waiting for news from the tomb, "as though the secrets of the spot would be violated by loud talk. Mystery hung as heavy on the place as mystery ever can in the full light of day." This photo was never published in the GEOGRAPHIC.

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■ NEW AT YOUR LOCAL IMAX THEATER Ancient Egypt Reborn on Colossal IMAX

The young king Tutankhamun begins his journey into the afterlife 3,300 years ago surrounded by worldly splendor (below) in the meticulously researched film Mysteries of Egypt. National Geographic Television's first giant-screen-format project, the film tells the history of the ancient Egyptians on a scale befitting their vision: They planned grandly and built magnificently.

The epic of Egypt unfolds on IMAX screens taller than the Sphinx. Sweeping aerial views of the mighty Nile River, source of Egyptian wealth and culture, give way to overviews of the Pyramids at Giza. Viewers tour the burial chamber of a Pyramid and descend into tombs in the Valley of the Kings, where brilliant paintings tell of the pharaohs' journey through the netherworld and of the dangers they faced in their quest for eternal life.

Our guide is Egyptian actor Omar Sharif (above right). As he introduces his on-camera granddaughter to the wonders of ancient Egypt, he weaves a tale of accomplishments in astronomy, mathematics, and construction—the magic of the pharaohs' realm.



PROGRAM GUIDE

National Geographic

NBC. See local listings.

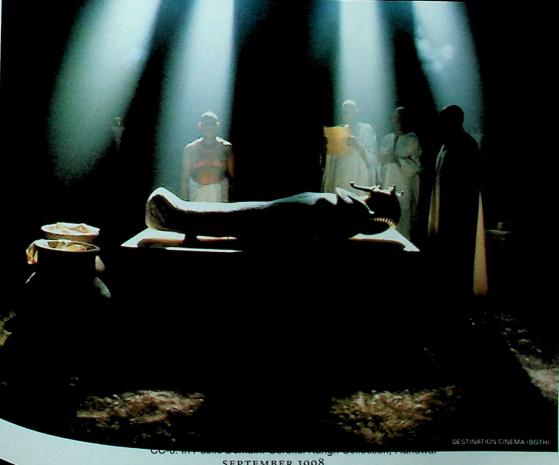
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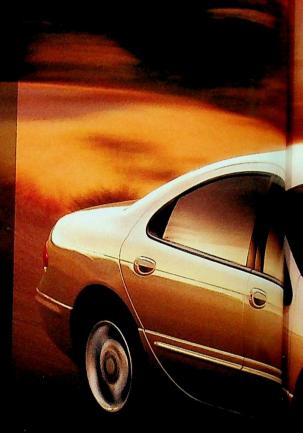
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Look for the National Geographic Channel when traveling in Europe, Australia, and Asia.



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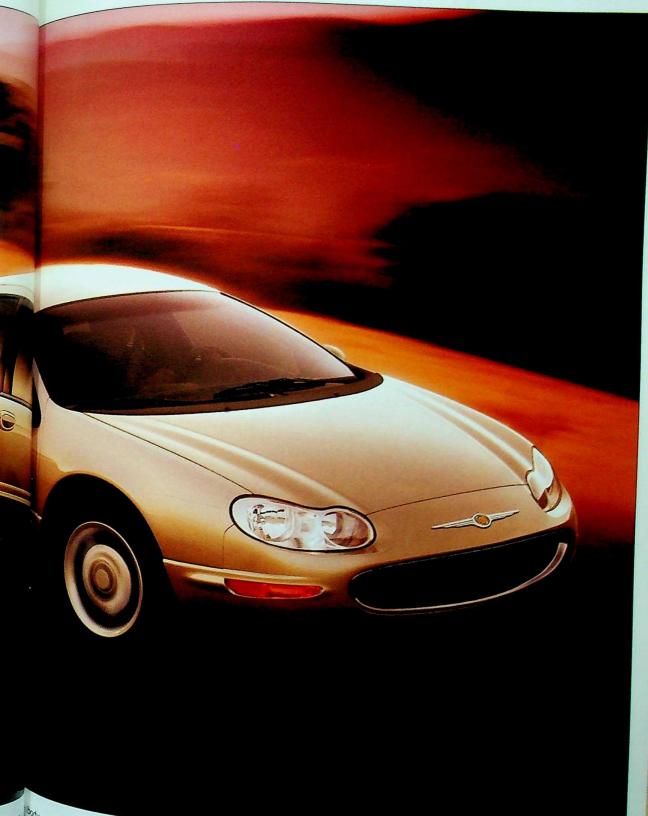


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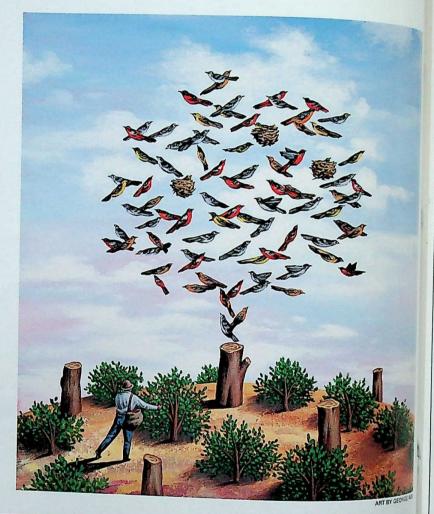


EarthAlmanac

Migratory Birds Need a Coffee Break Too

Warblers, orioles, thrushes, and other songbirds that winter in Mexico and Central America are declining. One reason may be the change on southern coffee plantations.

For a century coffee bushes have been grown under shade trees loved by songbirds; such plantations may support 150 species. Since the 1970s, coffee grown in full sun for a higher yield has increased; shade trees have been cut down. In Mexico about 50 percent fewer songbird species are found. Conservation groups such as the Smithsonian Migratory Bird Center promote shadegrown coffee, still widely produced.



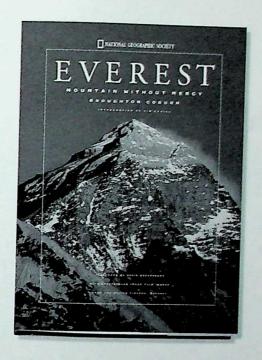


MARTIN HARVEY, NHPA

Dingoes: Hated by Man, Menaced by Kin

Shot, trapped, and poisoned by ranchers and sheep farmers, dingon Australia's wild dogs (Geographic April 1997), do have defenders. Equ ogist Laurie Corbett says "it is incur table that pure dingoes will become extinct in the next 50 to 100 years due to crossbreeding with dogs. goes probably sailed to Australia from Asia with traders some 3,500 years ago. Now proliferating hybrids wiff farmers. Dingoes breed once a year hybrids, like dogs, breed twice a

WITNESS TRIUMPH AND TRAGEDY AT THE TOP OF THE WORLD



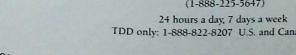
In May 1996, a team of filmmakers and climbers ascended Mount Everest, only to be caught up in a tragedy-and rescue—that stunned the world. Now, National Geographic brings you their riveting story: a stunning portrait of this hostile, beautiful realm...and a firsthand profile of the men and women who dare to challenge it. Climbers' anecdotes and spectacular IMAX® images enhance this saga of courage and determination. Experience high adventure at its breathtaking best...Everest: Mountain Without Mercy.

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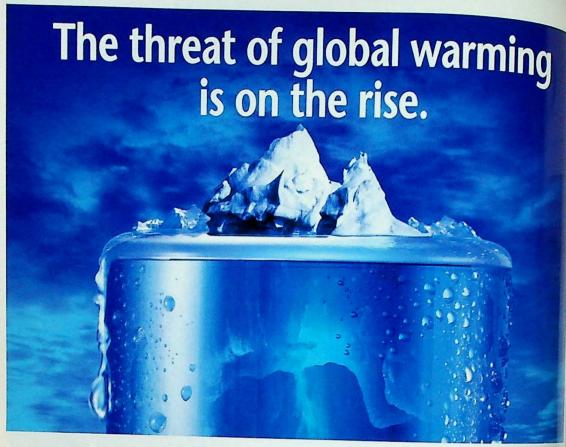
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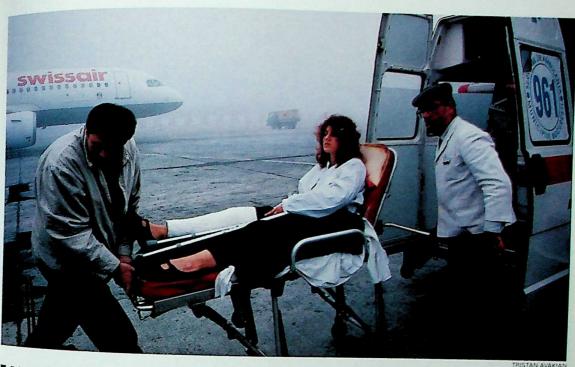


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A Break in the Action

It was not the end of the road for photographer Alexandra Avakian—but it sure seemed that way. A surging crowd on a Danube ferry shoved her off the boat's boarding ramp. She was left dangling upside down above the river—her knee mangled

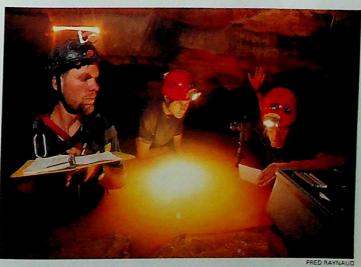
in a wire cable. Alexandra's brother, Tristan, flew in from New York to bring her home. After surgery she endured seven months of grueling physical therapy before returning to Romania to finish the shoot.

Fascinated by photography since age 11, Alexandra took inspiration from her father, film director Aram Avakian. "I learned a tremendous amount from him about telling stories with images."

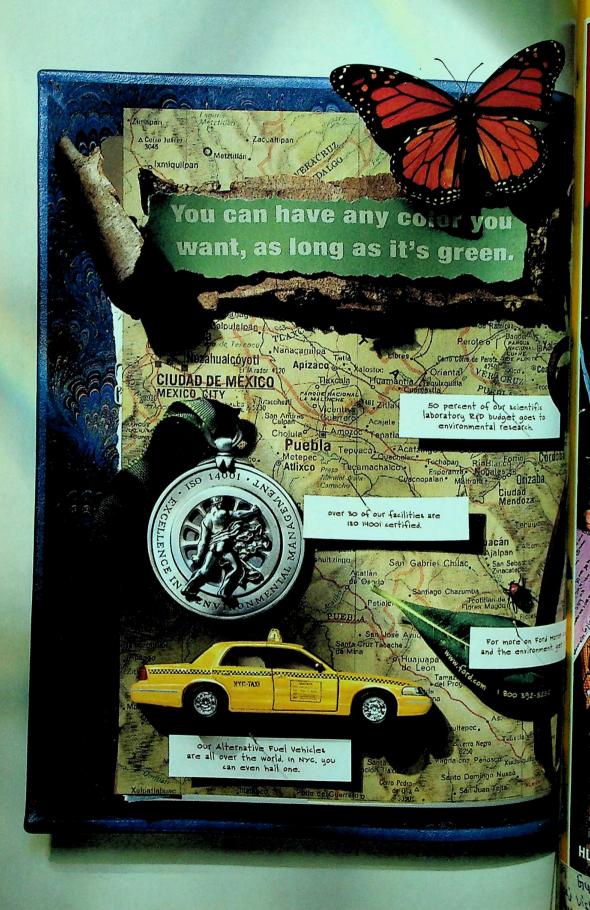
■ BORNEO CAVES

Dampened Enthusiasm

"I got used to working in waist-deep Water in Borneo," says photographer Stephen Alvarez, at far right, here checking test shots in a cave with his assistant Neeld Messler, center, and expedition cartographer Chris Andrews. Swimming in a rain-Swollen river there, Stephen was yanked under by fierce currents and nearly drowned. Borneo has other hazards, warns the Tennessee native. Think of the place on your body where you'd least like to see leeches. That's just where they like to go."



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MILLENNIUM SUPPLEMENT: POPULATION
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OCTOBER 1998

HUMAN MIGRATION 6 WOMEN AND POPULATION 36 FEEDING THE PLANET 56 LEWIS AND CLARK 76 PERFUME 94 ANTARCTIC DESERT 120 vishwavid.

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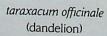
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NATIONAL GEOGRAPHIC

From the Editor



KAPEN KASMALIS

EVERY TEN SECONDS the world's population increases by 27 people. That's not a conjured-up scare statistic. It's just a statement of fact, according to the Population Reference Bureau. With luck those 27 people will have enough food to eat and clean water to drink and will dwell in decent homes. They will become farmers, teachers, salespeople, and magazine editors. If all goes well, they will live to a ripe old age.

They will also clear forests for agriculture and housing, generate bargefuls of sewage, and choke rivers with fertilizer runoff. And therein lies the challenge of balancing world population growth with our planet's biodiversity.

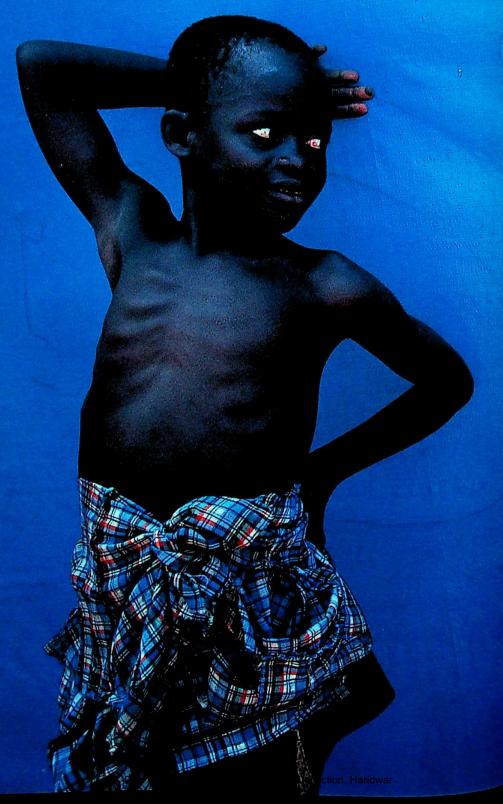
Our millennium coverage continues this month with a series of articles addressing population. The first tackles the issue of human migration. People have long sought to spread out from their places of origin, whether they crossed a land bridge from Asia to North America, boarded wooden ships westbound from Europe, or pushed through the vast forests, deserts, and mountain ranges of Africa. Wherever they've roamed, women, as the bearers and traditional nurturers of children, have faced their share of hardship. In "Women and Population" we explore the status of women as a critical factor in population issues. Finally there is the matter of feeding the 5.9 billion people living today and the billions more that the Earth will have to support in the decades to come.

In a forthcoming issue we will examine global biodiversity and how we can attain a sustainable relationship with the plants and animals with which we share our increasingly crowded planet.

Bill allen

Digitized by Arya Samaj Foundation Chennai and eGangotri

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By Joel L. Swerdlow ASSISTANT EDITOR

HULATION



One in six billion

An African refugee, part of a recent wave of migration, grows up in a paradoxical world of falling birthrates and soaring human numbers, record harvests and widespread hunger.

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KAREN KASMAUSKI

It takes only 12 years or so to add



The millennium series spotlights six subjects shaping human destiny. Articles in the February 1999 issue will focus on biodiversity.

F ALL THE ISSUES WE FACE as the new millennium nears, now is more important than population growth. The number speak for themselves. Earth's population, which total 1.7 billion people in 1900, is now nearly 6 billion—at: growing.

But when I talk about this issue, someone invariably asks. "How can there be a population problem when so much land is emptor It's a logical question. If everyone on Earth moved to Texas, we'deat have about 1,200 square feet of living space. The rural heartland of United States is, in fact, emptying out as farming becomes more medanized. ■ I have a personal tie to this empty zone. In 1905 my grand father left Russia for Logan County, North Dakota, seeking opportunit and freedom from oppression. Virtually all of us, as Michael Pari points out in "Human Migration," have such journeys in our familiant history.
My father was born in a sod hut in 1909, and his family North Dakota for Bayonne, New Jersey, in 1918, part of the rural-tourban shift that is reshaping the world. When my father was your almost 90 percent of the world's people lived in the countryside. No nearly half live in cities. ■ Logan County's population peaked in 1930# 8,100 people. It's now below 2,500. Abandoned farmhouses and batts dot the landscape. ■ "I'm 47 and one of the youngest people active" my community," says Randy Mundt, a banker in Wishek, the neighbor ing McIntosh County town where my father attended school. "There's no next generation for me to hand community responsibilities over 10 because young people are moving away." A shortage of people isn't or a concern in rural areas. Lower birthrates contribute to an expected drop in the populations of Japan and Western Europe.

Dedinie population? Since long before Paul Ehrlich's 1968 book, The Population Bomb, haven't experts warned of mass starvation? Such predictions di not anticipate the new plant varieties and technological advances of recent decades that have boosted yields of wheat and maize, for example by nearly 80 percent. And by 1970 global population growth rates had peaked. ■ As Erla Zwingle explains in "Women and Population," bir rates abate as women gain access to contraceptives, health care, education tion, and economic opportunities. Today 98 percent of growth occur in the developing world—where these benefits are least available

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another billion people to the population. -WOLFGANG LUTZ, DEMOGRAPHER

■ By raising awareness, experts' dire predictions may have helped slow

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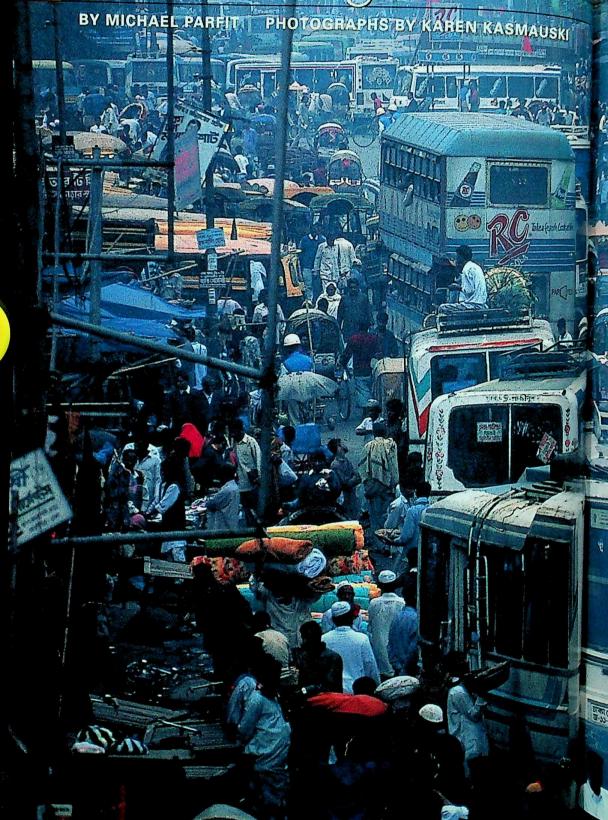
population growth. But the crisis, or at least the potential crisis, has not disappeared. We have no guarantees that a population rise that outstrips food and water supplies does not await us—the United Nations' highest current projection is 11 billion people by 2050.
Curtailing overall numbers, furthermore, does not solve all population problems. As we become more urban and industrial, we consume more resources and generate more pollution. China, whose cities now hold 350 million people, has lost 20 percent of its arable land since the late 1950s. What further environmental damage—and social unrest—could occur as Chinese crowd into cities? In "Feeding the Planet" T. R. Reid concludes that the chief problem isn't our capacity to produce food but rather how food is distributed. His article highlights an ongoing debate. Optimists point out that a crisis is not inevitable. Technological innovation, they say, will always keep food supply a step ahead of population. Pessimists warn that we can't count on technological fixes to rescue us from population problems. By changing the environment, moreover, agricultural technology itself contributes to problems, such as loss of biodiversity, that are likely to worsen as our numbers increase. ■ Concerns about overpopulation seem far away as I drive through Wishek, North Dakota, which is so small it has no traffic light. Wishek Steel and Manufacturing catches my eye. ■ Owners Harley and Carol Brandner, ^{once} local wheat farmers, explain that they started a welding repair shop here in 1969 and then patented "a spring action in which a whole section of discs rises when it hits a rock," making it easier to cultivate hard, stony soil. This invention is now at work in the Hulun Buir grasslands of Inner Mongolia. Overgrazed and prone to erosion, that faraway barren area will soon yield alfalfa. ■ The Brandners' tiller seems perfect for the land my grandfather often called "rough and hard." Following an old county map I drive along dirt roads, searching for his farm. Wheat fields surround me. I find the family homestead, which I am surprised to see is how a federal wildlife management area. Meadowlarks nest in knee-high grass. Standing where my father was born makes the land come alive. Will we have the wisdom, it seems to ask, to live in balance with the natural world as we grapple with the needs of our growing population?

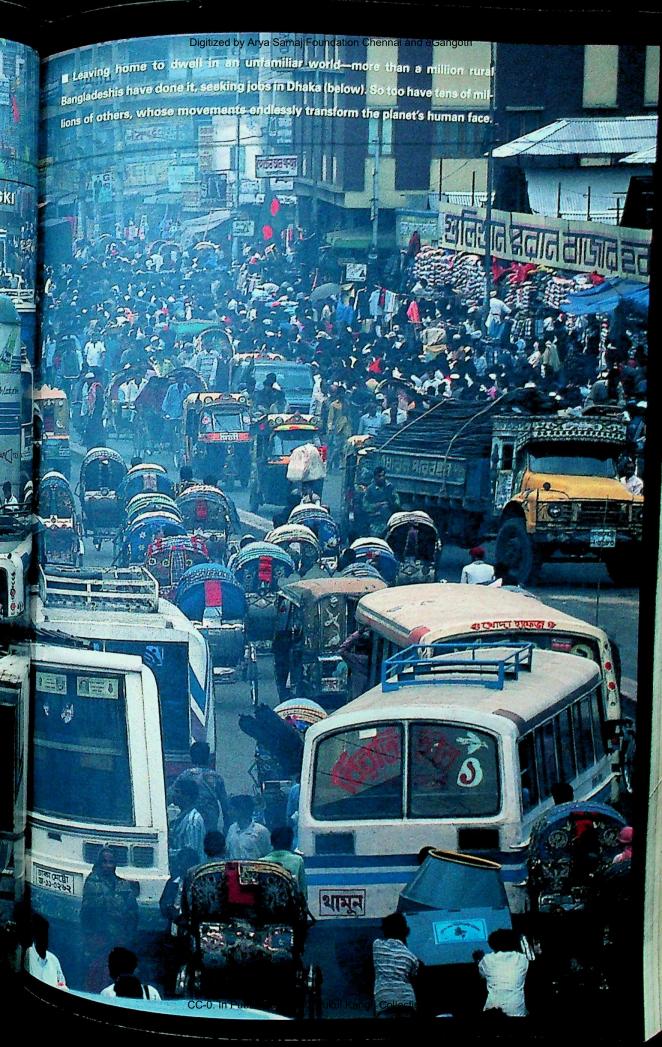
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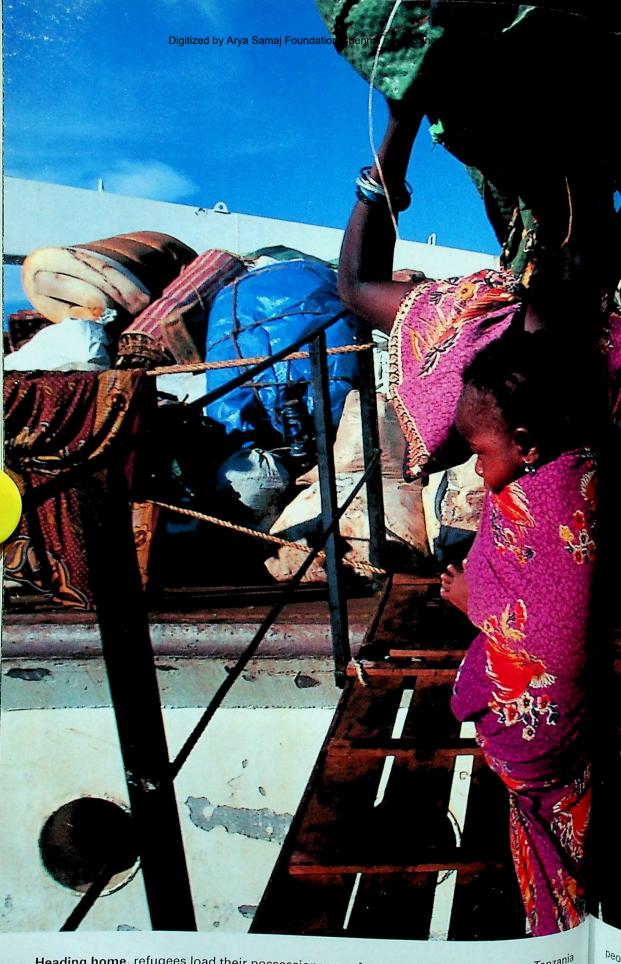
Be part of cutting-edge research at http://sur vey2000.nationalgeo graphic.com. Your responses will help us explore the meaning of community on the eve of the millennium. Results from this innovative Internet-based study will be posted for all to consider.

THE MILLENNIUM SERIES

Human Migration







Heading home, refugees load their possessions on a ferry that will take them from Tanzania across Lake Tanganyika to the Democratic Republic of the Congo. Conflict in central Africa has fueled the growth of the war has been populated and will be the standard of the congo. The congo is the congo in the congo in the congo in the congo is the congo in the

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Deople in the mid-1960s to 15 million people today. "That's a significant number, but refugee more tumultuous time. "It's been better," he says, "and worse."

Behind the relatively stable appearance of

HAT CHUCK JUHN noticed most was the quietness. The road was full of people, but there were no voices. Hundreds of people—thousands—walked past him. This many voices would make a football stadium thunder. But they were silent.

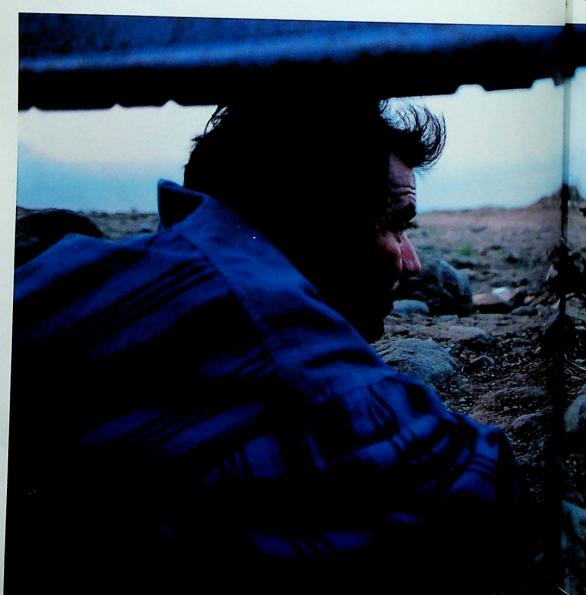
They just walked, so many people that they filled the road, edge to edge, as far as Juhn could see, and all he heard was the soft, weary

whisper of feet on the road. The people use every last scrap of energy just to keep moving

"People at the margin don't mess around remembered Juhn, an American aid work who was in Rwanda at the time. "They didn's ay a word. Total silence. They were so washo out and skinny; it was like some other real moving through."

Juhn was watching one of the great single movements of people in recent years. It has pened in December 1996. It was the sudden

Pondering his next move, José Alonzo peers under a fence at the U.S.-Mexico border in Tijuana. His first attempt to sneak into the U.S. failed. Now, like countless of his countrymen, he waits for an opening to dash north, get a job—and then lie low.



the world, people are moving, quietly.

return of more than 450,000 Rwandan refugees from camps in Tanzania to their home country after the brutal upheavals of 1994 and 295. Forced out of Tanzania by government deadlines, the refugees left the huge camps in less than a week and started walking home.

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"I'm glad I saw it," said Juhn, when I talked to him recently in Tanzania, "but I don't ever want to see something like that again."

He may not—movements of thousands of people seldom occur so suddenly, or so visibly. But something like this happens every day. Behind the relatively stable appearance of much of the world, the same kinds of numbers are moving, almost as quietly. In airports and

seaports and railway stations, along forested borders, and even where steel and barbed wire make barriers that seem impenetrable, thousands upon thousands of people are on their way to somewhere new. They don't make much noise, but they change the world.

Human migration: The term is vague. What people usually think of is the permanent movement of people from one home to another. More broadly, though, migration means all the ways—from the seasonal drift of agricultural workers within a country to the relocation of refugees from one country to another—in which people slake the fever or need to move.

Migration is big, dangerous, compelling. It's Exodus, Ulysses, the Battle of Agincourt, Viking ships on the high seas bound for Iceland, slave ships and civil war, the secret movement of Jewish refugees through occupied lands during World War II. It is 60 million Europeans leaving home from the 16th to the 20th centuries. It is some 15 million Hindus, Sikhs, and Muslims swept up in a tumultuous shuffle of citizens between India and Pakistan after the partition of the subcontinent in 1947.

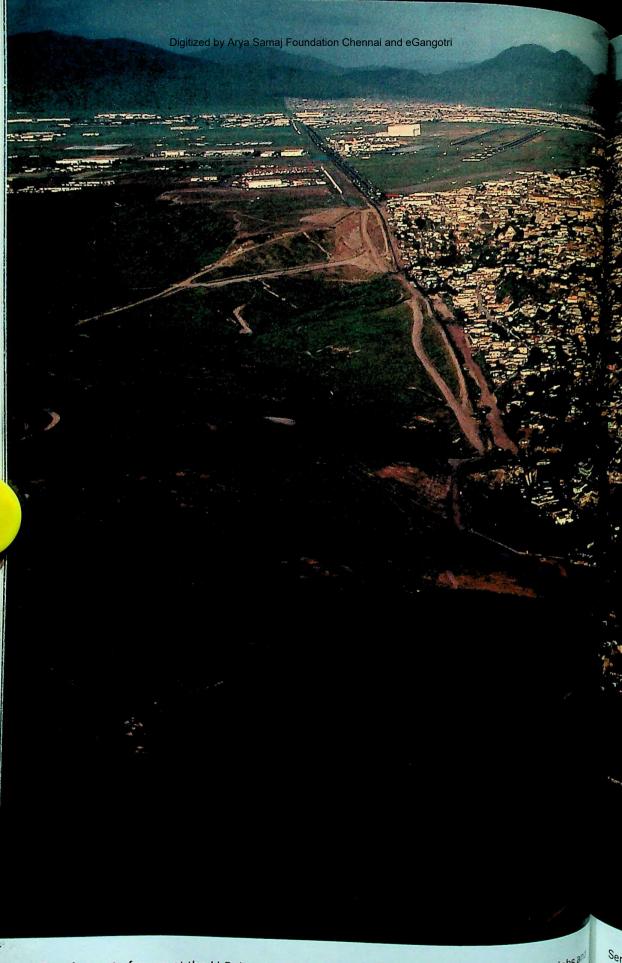
Migration is the dynamic undertow of population change; everyone's solution, everyone's conflict. As the century turns, migration, with its inevitable economic and political turmoils, has been called "one of the greatest challenges of the coming century."

But it is much more than that. It is, as it has always been, the great adventure of human life. Migration helped create humans, drove us to conquer the planet, shaped our societies, and promises to reshape them again.

OU HAVE A HISTORY book written in your genes," said Spencer Wells. The book he's trying to read goes back to long before even the first word was written, and it is a story of migration.

Wells, a tall, blond geneticist at Stanford University, spent the summer of 1998 exploring remote parts of Transcaucasia and Central Asia





Running out of room at the U.S. border, Tijuana attracts Mexicans who move there for jobs and for a chance to head north some day. Lax security here in the late 1980s and early '90s embeding and a steady stream of the late 1980s and early '90s embeding the late 1980s embed embed

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Service to launch Operation Gatekeeper in 1994. The program beefed up border patrols and stanched much of the illegal influx, but it failed to dissuade those tough enough to travel where they make an Emplis Panain Guruku Kangri Cale and Hidre dangerous terrain.

with three colleagues in a Land Rover, looking for drops of blood. In the blood, donated by the people he met, he will search for the story that genetic markers can tell of the long paths human life has taken across the Earth.

Genetic studies are the latest technique in a long effort of modern humans to find out where they have come from. But however the paths are traced, the basic story is simple: People have been moving since they were people. If early humans hadn't moved and intermingled as much as they did, they probably would have continued to evolve into different species. From beginnings in Africa, most researchers agree, groups of hunter-gatherers spread out, driven to the ends of the Earth.

To demographer Kingsley Davis, two things made migration happen: First, human beings, with their tools and language, could adapt to different conditions without having to wait for evolution to make them suitable for a new niche. Second, as populations grew, cultures began to differ, and inequalities developed between groups. The first factor gave us the keys to the door of any room on the planet; the other gave us reasons to use them.

Over the centuries, as agriculture spread across the planet, people moved toward places where metal was found and worked and to centers of commerce that then became cities. Those places were, in turn, invaded and overrun by people later generations called barbarians. The names of some of these groups have become symbols of upheaval: Hittites, Scythians, Visigoths, Vandals, and, lest we forget, Attila's vigorous warriors, the Huns.

In between these storm surges were steadier but similarly profound tides in which people moved out to colonize or were captured and brought in as slaves. For a while the population of Athens, that city of legendary enlightenment, was as much as 35 percent slaves.

"What strikes me is how important migration is as a cause and effect in the great world events," Mark J. Miller, co-author of *The Age of Migration* and a professor of political science at the University of Delaware, told me recently.

No stranger to migration, MICHAEL PARFIT was born in England and raised in Michigan, Connecticut, California, and Brazil; he now resides in Montana. While growing up in a military family, KAREN KASMAUSKI moved frequently; today Virginia is home.



It is difficult to think of any great events that did not involve migration. Religions spawned pilgrims or settlers; wars drove refugees before them and made new land available for the conquerors; political upheavals displaced thousands or millions; economic innovations dreworkers and entrepreneurs like magnets; environmental disasters like famine or disease pushed their bedraggled survivors anywhere they could replant hope.

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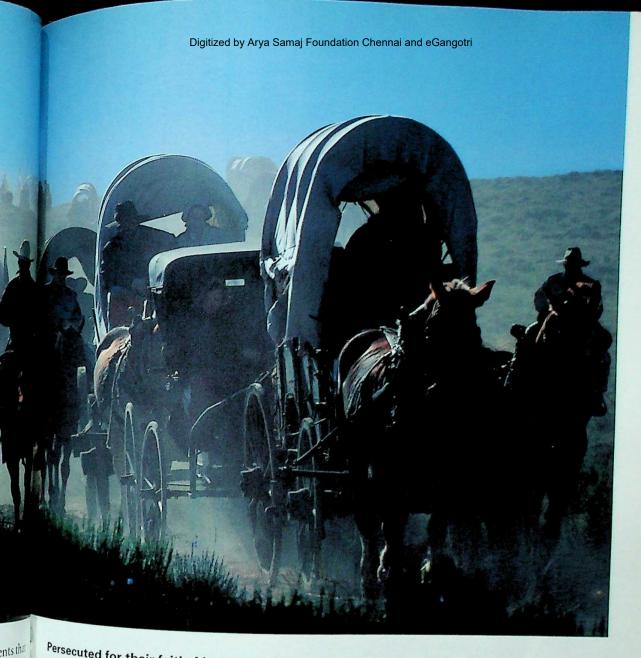
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"It's part of our nature, this movement Miller said. "It's just a fact of the human condition."

What drives this fact of nature, and how it likely to change humans next? Over the pust months I met a lot of people who were in various stages of migration. Without exception they were kind and gentle people. But the forces that drove them were ruthless.



Persecuted for their faith, Mormons were forced to leave Missouri by order of the governor in 1838. By 1846 many Mormons had embarked on a harrowing 1,300-mile trek west from Illinois to present-day Utah, a migration recently re-enacted by the faithful (above).

T WAS DURING the nighttime when the soldiers came," said my interpreter, Muhammad. "They started to kill people; I mean shooting. And some of [the refugees'] relatives were killed. Yes, some of their family were killed."

I was in an enclosure on the Tanzanian shore of Lake Tanganyika. The roof was a blue tarp, Printed UNHCR: United Nations High Commissioner for Refugees. The UNHCR has programs in over a hundred countries and in 1997 had a role in the lives of 22 million people.

About 20 refugees from the small African hation of Burundi, which adjoins Tanzania to the northwest, sat inside. The day before they

had come to this receiving center by boat down the coast of Lake Tanganyika. Among them was a refugee who told Muhammad in Swahili what had happened just a few days earlier.

He spoke impassively, as if explaining a machine. Beside him sat his wife and baby. He was 20; his wife was 18. The child was 9 months old and had sores all over his scalp.

"This man was with his parents there," Muhammad explained. "Up to this moment he does not know whether his parents are alive or if they were killed. For seven days they are walking, coming to this country."

I did not know what to say. The refugee looked at me without emotion, as if to say: This

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is too serious for sympathy. Twenty other pairs of eyes in the enclosure looked at me calmly and said the same thing.

"For you, shocking," said Muhammad. "But for us, not, because this we are hearing day and night."

A ledger kept here by the organization Chuck Juhn worked for, the International Rescue Committee, told a brutal story of the health of the incoming refugees: Malaria, dislocated shoulder, malaria, bullet wound, bullet, bullet, bullet, multiple bullet.

Scholars call this "forced migration." Most of the 20 million or more people a year who are involved with the UNHCR are fleeing from conflict. The number fluctuates widely. In 1991 it was 17 million; it grew to 27 million in 1995 and declined to 22 million in 1997.

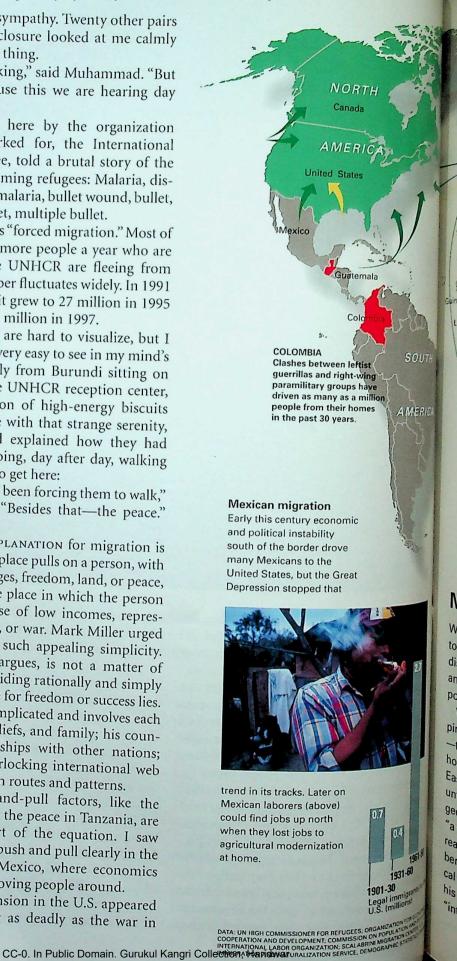
These numbers are hard to visualize, but I will always find it very easy to see in my mind's eye the little family from Burundi sitting on a straw mat in the UNHCR reception center, waiting for a ration of high-energy biscuits and looking at me with that strange serenity, while Muhammad explained how they had kept themselves going, day after day, walking through the bush to get here:

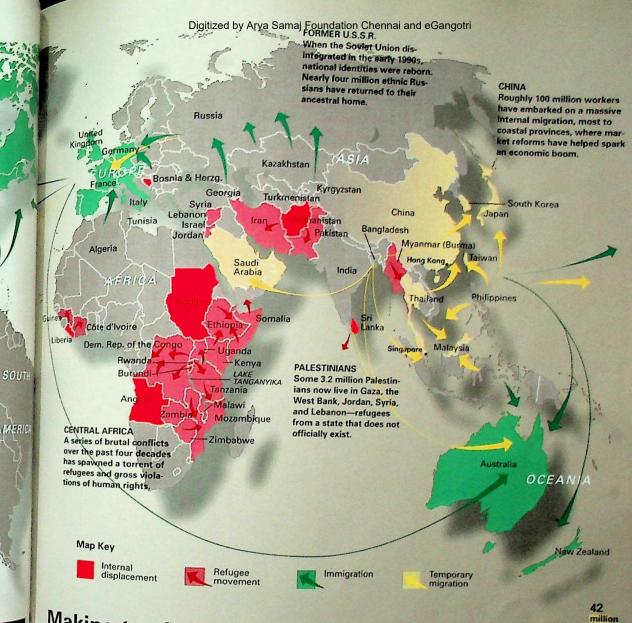
"The hunger has been forcing them to walk," Muhammad said. "Besides that—the peace."

SIMPLE EXPLANATION for migration is that one place pulls on a person, with good wages, freedom, land, or peace, while the place in which the person lives pushes because of low incomes, repression, overcrowding, or war. Mark Miller urged me not to fall for such appealing simplicity. Migration, Miller argues, is not a matter of each individual deciding rationally and simply where the best hope for freedom or success lies. It is much more complicated and involves each person's history, beliefs, and family; his country's prior relationships with other nations; and the whole interlocking international web of existing migration routes and patterns.

However, push-and-pull factors, like the war in Burundi and the peace in Tanzania, are unquestionably part of the equation. I saw another part of the push and pull clearly in the United States and Mexico, where economics was hard at work shoving people around.

At first border tension in the U.S. appeared to me to be almost as deadly as the war in





Making tracks: migration in the 1990s

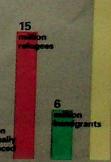
What drives migration? Demographers point to the interaction of two forces: the lure of a distant place—hope of a job, for instance—and the negatives of life at home, such as political unrest or a natural disaster.

While men and women in, say, the Philippines are often motivated by both impulses the "push" of an anemic economy at East—other migrants are uprooted involuntarily, often at gunpoint, and become refusively defined as a person who has reasons of race, religion, nationality, memcal opinion," a refugee must reside outside "internally displaced."

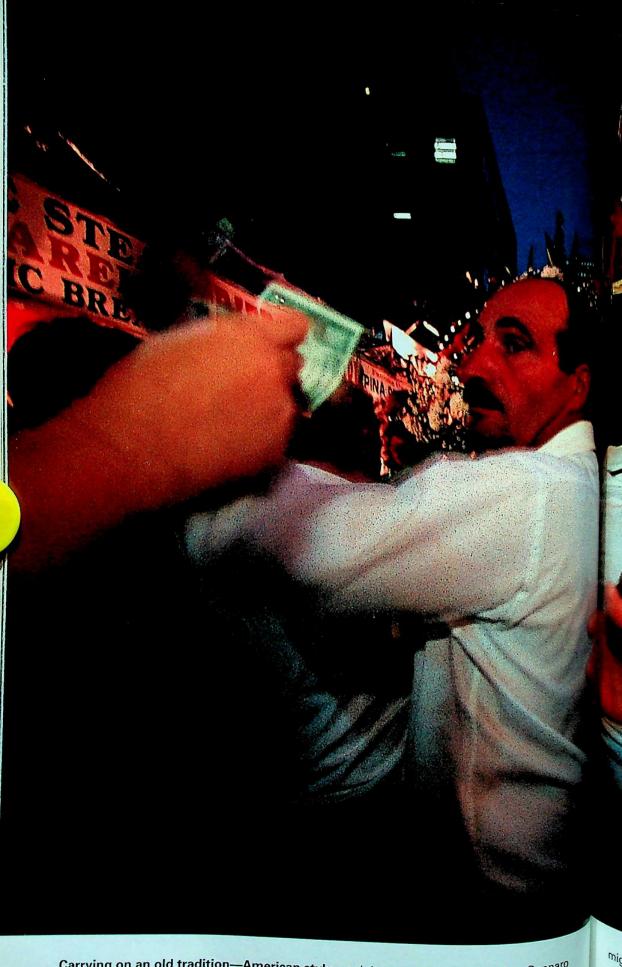
Native Americans and similarly uprooted indigenous groups are often missing from official statistics because the UN and other organizations use the post-World War II political map as a baseline. People displaced prior to that era are generally not tallied.

COUNTING HEADS

Estimates of the total number of "internally displaced" persons vary widely. Some experts believe this group might be as large as 50 million.



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might imagine," says Father Fabian Grifone. "But as long as organized crime stays out of it, the from Naples, where the tradition began and where it remains a one-day religious event.

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Shadows of the slave trade

Abandoned slave cabins on a Florida plantation belonged to Zephaniah Kingsley in the 1830s, but mounting racial tensions persuaded him to take his wife—who had once been his slave—and their sons and move to the Caribbean. Near Miami an animist tradition called Ayoba (below), with roots that run from West Africa through Cuba, attracts many African Americans on spiritual sojourns of their own.





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Burundi: Human beings look wrong when you find them lying in an alfalfa field facedown. They have the wrong dimensions; they look too thick. It is chilling to see them lying so still.

Luis Diaz, a U.S. Border Patrol watch commander, and I had found the bodies with the help of another agent, named Peter, who had a big night-vision scope mounted in the back of a pickup. By two-way radio he had guided Diaz and me across the field. "More to the east. Now south." Suddenly there the bodies were, lying facedown, looking like packages of hay wrapped in colored cloth, so much more still than they ought to be in the chilly damp moonlight of a California February night.

"Make a line!" Diaz said to the bodies in Spanish. (Border agents here seem to call all illegals "bodies," as in, "There's two bodies moving toward area five.")

"Hands on your heads!" Diaz went on. "Over to the car!" The bodies, which had looked entirely dead, all got up, brushed off dirt and leaves, and started walking. "How did you see us?" one of them asked in Spanish. Diaz didn't answer. "I'll let him figure it out," he told me later.

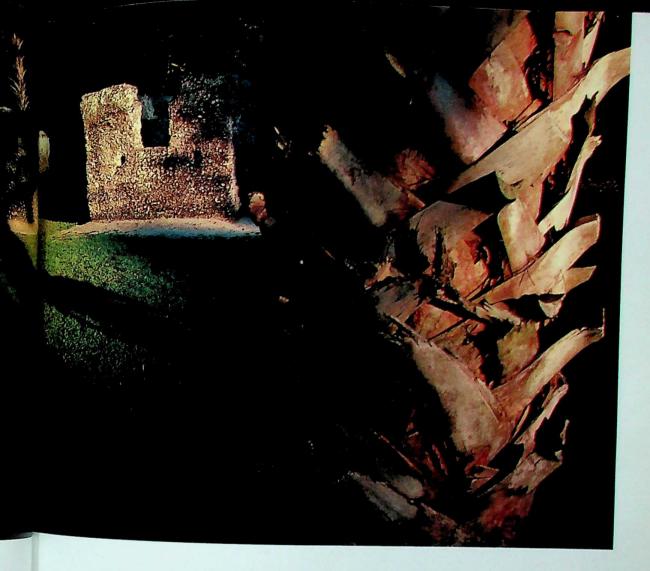
"Where're you going?" Diaz asked them. "Al otro lado," one said.

"St," said Diaz, "but where on the other side"
"Don't know," said one. "Los Angeles?"
"Is it beautiful, Los Angeles?" said another
"Well," said Diaz, "it's big."

People from Central and South America can the United States El Norte, but to many Mericans it is just over there, the other side sounds mystical. In a way, for Mexicans buried in poverty, it is.

"A better life," said Alejandro Bermude Pérez, when I asked him why he had tried of cross. He was in a holding tank at Luis Dian Calexico headquarters. There, at a desk surrounded by rooms that can hold a total about 300 people, Alejandro was waiting to fingerprinted and photographed by high-ten computer identification equipment.

He was a lean, quiet man of 24. He told



about his wife and child, who lived at the edge of Mexico City. He had come to the border by bus and wanted to get work in the U.S.

"Now that you've been caught, what will you do?" I asked.

Alejandro stared at me with his solemn young face, and looked as if he was going to break out laughing. What did I think, asking

But he maintained a straight face; he wasn't about to tell me in front of an agent that he'd be coming right back at him tomorrow.

"Maybe," he said innocently, "now I'll go back to Mexico City."

Alejandro's choice to go north is a perfect example of economic migration. This form of Morla p has lots of numbers behind it. The World Bank estimates that only 15 percent of the world's almost 6 billion people live in the 22 highest income countries, where the average income: income is more than \$25,000 a year. Nearly all the rest, as well as most of the 80 million or so people added to the world each year, live in

countries in which income is close to or less than the global average of \$5,000 a year.

This would seem to create a straightforward flow from poor to rich. But it is not that simple. Some 120 million people in the world live in countries other than the one in which they were born, but more than half of these have moved to other developing nations, where the average income is little better than the countries they left. In addition, though you'd think that the poorest people would be the ones most prone to migrate, that's not so either. The image of throngs of abject poor clamoring on the borders of the wealthiest nations is wrong.

"The world's poorest people don't move, for the most part," Mark Miller said. Though driven by need, the people who do move are usually those who can come up with a few extra dollars for the trip.

It's easy to see how a rich nation like the U.S. could get the wrong impression of its immigrants: On the U.S. side of the border, people like Alejandro look like criminals, climbing

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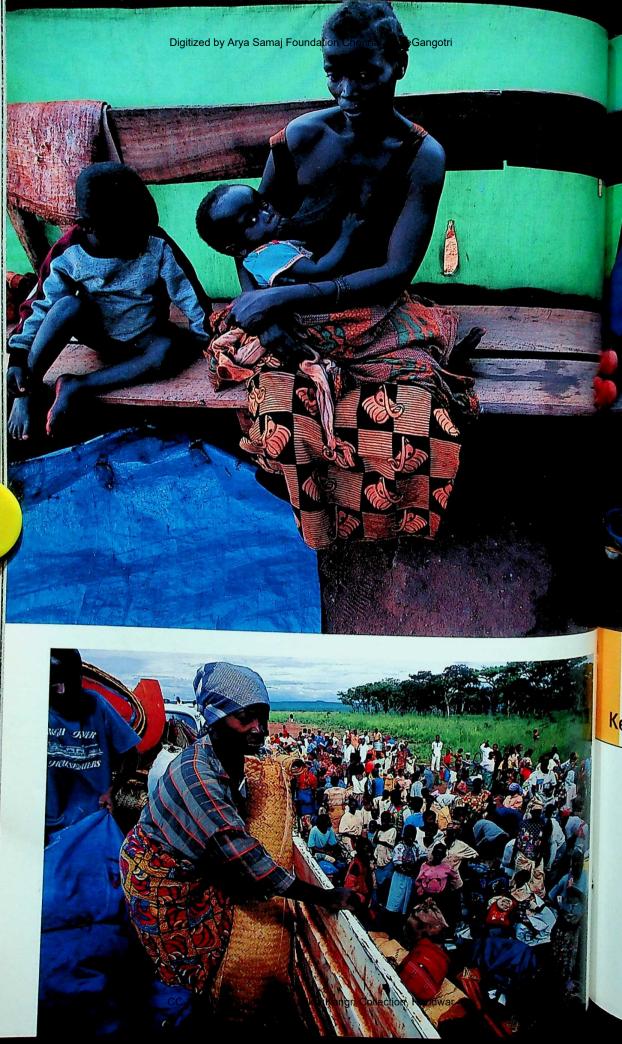
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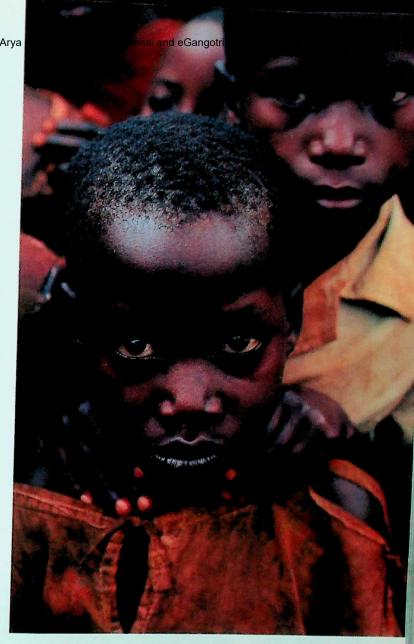
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Keeping out of harm's way in central Africa

Bloody clashes in the heart of Africa have driven millions of people from their homes, including 332,000 refugees who in early 1998 resided in camps just inside the Tanzanian border. Near Kigoma, Jeanne Buchumi and her two children (above left) fled from fighting between Tutsis and Hutus in Burundi. At the

Mtendeli camp some 31,000 refugees, many of them children (above), still await repatriation. The end of the civil war in the Democratic Republic of the Congo persuaded some evacuees to return home in March (left). One relief worker, asked to characterize the mind-set of a typical refugee, replied: "Stoic."

fences, slipping through the shadows, trying to evade the cops, hiding out in slums, ignorant of the language, dressed in clothes they've worn while lying in alfalfa fields.

But at home, they're heroes.

NE SATURDAY IN MARCH I took a green Volkswagen taxi out of downtown Mexico City to an area northwest of town, where dense waves of small concrete-block homes wash up into the hills, the edge of that city's rising tide of humanity. There, in a small room painted a sunny yellow, in which a patched aquarium gurgled on top of a refrigerator, I talked with Alejandro's family. "When you have a son," his wife, Lourdes,

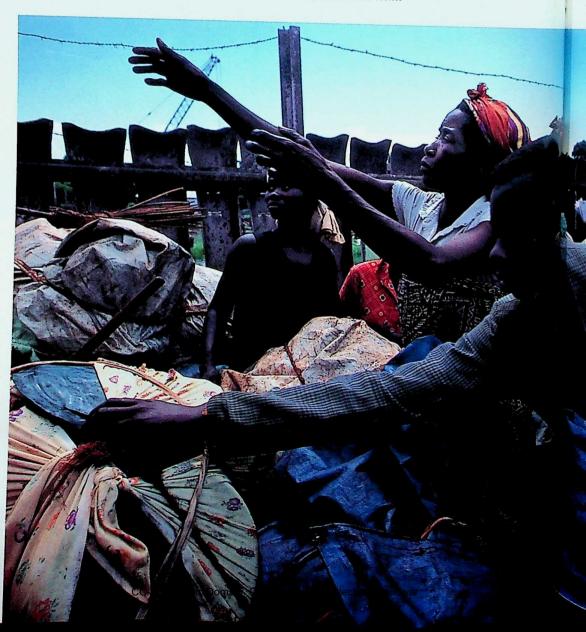
said, "you don't think of yourself. You have make sacrifices. To tell the truth, he knew it going to be difficult."

Around the table were Aleiands.

Around the table were Alejandro's mother brother-in-law, and his younger brother, Cow who recently tried five times to cross to other side and got caught each time. He's got to try again. "It's like a little worm inside" said. "To go to the other side."

The family had heard from Alejandro, He called from California. After three or for attempts he had made it to the other side at was living with a few others who had crosse with him somewhere near San Diego. The didn't know how he was living, but I suspected it was in one of several infamously tour

On the move again, Congolese refugees grab their baggage before boarding a ferry to go home. Repatriation from Tanzania is a choice for these refugees, whose decision—to go or stay put—is influenced by radio broadcasts and the rumor mill.



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shanty campgrounds in the hills near the city.

The family had planned the trip seriously.

The family had plainted the trip scriously. In Mexico, Alejandro had been making 600 pesos a month (about \$70) as a car mechanic; from that and with loans from relatives they had saved the equivalent of almost a thousand dollars, some to pay for his bus fare and a fee to a pollero—a guide to get him across the border—and some to keep Lourdes going until the dollars Alejandro made started to flow south.

The long-term goal was to save enough money so they could open a small business, probably a car repair shop, in Mexico City.

"That is our dream," Lourdes said. "To tell the truth, if he were just working here that dream could not come true. Never."

Wondering whether their hopes for Alejandro were romantic or realistic, I asked them if they knew many people who had come back rich enough to do what Lourdes hoped.

"Sí, some people," said Alejandro's brotherin-law. "But we also know people who have come back with nothing."

Lourdes had her son on her lap, two-yearold Jesús Brandon Bermúdez Bautista. He was wide-eyed and curly headed.

Before Alejandro left, Lourdes had small photographs of the three of them put in key chains; one for her, one for him, "for the times when he needs to encourage himself to go on," she said.

"To tell the truth," Lourdes went on, "after he left I worried about Alejandro every day. When he got there, I cried. Then I rested a little from that fear that I had."

It was a pleasant morning, with warm air drifting through open doors and windows, a jacaranda tree blooming outside, voices of the children playing, and this competent and hopeful family talking about the loved one they'd launched into the distance. Watching them, I thought of Alejandro, living on the run in San Diego County, looking for any kind of work so he can send money home. Even when it's driven by economics instead of war, migration is still full of risks and hardship.

Alejandro's mother, María Elena Pérez Ramírez, was no stranger to the hard realities of movement. She had been part of it. A worldwide flow has been moving to cities for years and has probably affected more people than any other form of migration. She moved to Mexico City from the countryside of the state of Guanajuato about 20 years ago, because poverty was even worse where she came from.

"I started the migration," she said with a laugh. "It is a chain."

NLIKE THE FLIGHT of refugees, which is usually chaotic, economic movement is a chain that links the world. Migration, a significant part of the trend toward a global system of communications and economics, continues to push us toward change.

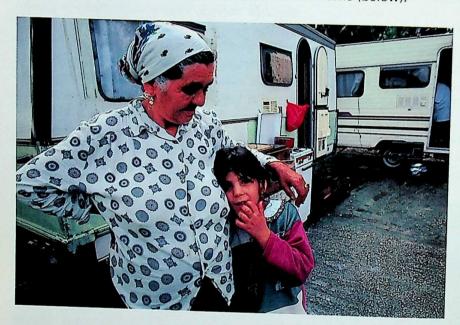
In the Philippines the culture is a buoyant chaos of Asian and Spanish influence from previous centuries busy with migration. Now this country sends its people off to work almost everywhere.

When I was in the Manila offices of the Overseas Workers Welfare Administration



With their will, there's a way

Following in others' footsteps, North Africans have learned to sneak into Europe via Italy's Lampedusa Island (right), just 70 miles off the coast of Tunisia. Arriving here on fishing boats, they are ferried to Sicily, where they are ordered to go home, but most flee north and disappear. Italy is also a haven for Gypsies, many of whom live in semipermanent trailer camps on the outskirts of Rome (below).





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(OWWA), I saw stacks of brochures to be given out to prospective migrant workers. The brochures were remarkably frank.

If you go to Singapore, one brochure said, "Good behavior means that: The maid . . . will not become pregnant." In Korea, another warned, "Employers are regarded as generally rude considering their strong voices and harsh ways. However, Filipinos . . . should not take this personally."

If you're going to Hong Kong, said another brochure, "OWWA advises the [worker] to . . . discard the 'Filipino time' mentality or face the consequences." For Saudi Arabia the advice was succinct: "If you think you are embarking for paradise, forget it."

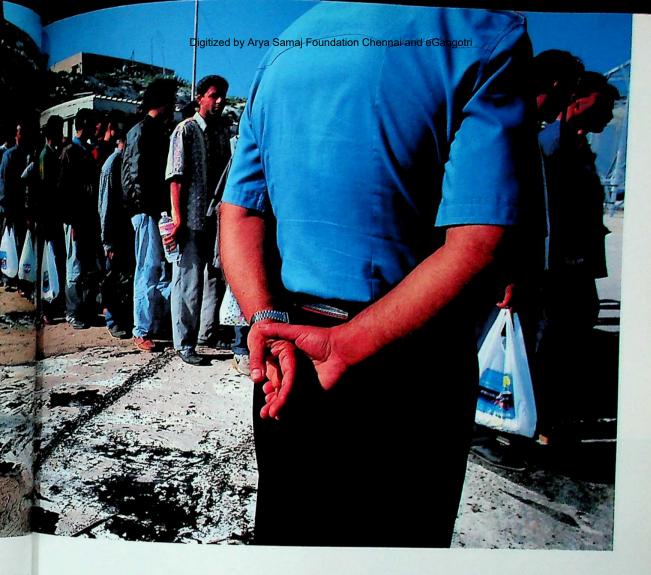
With a total population of 75.3 million people, the Philippines has 4.2 million working temporarily in more than 160 other countries, according to the OWWA. Of these, only 2.4 million are officially documented.

The Philippines experience demonstrates not only the global scope of migration; it also shows how far out on the edge of established society migrants can be. Countries that send migrants and those that receive them seem unable to deal with migration smoothly.

At home the Philippine government engage in complex and apparently contradictory practices. It does not officially encourage its people to work overseas, but it operates bureaucracie to help them go. Elaborate licensing systems ostensibly for regulation, are actually designed to discourage riskier overseas employment, like maids or "entertainers"—who are often destined for what one Filipino official delicated called "the flesh trade."

The same kinds of contradictory rule prevail elsewhere. South Korea, for instance calls its foreign workers trainees, though the may train at the same job for years at a time.

"A lot of countries are figuring out how open the labor market [to outsiders] with appearing to do so," said Ricardo Casco, director of the marketing branch of the Philippin Overseas Employment Administration.



When I visited Ricardo's building, the place was full of people applying for work, taking orientation, even demonstrating dancing ability. Ricardo himself was an energetic, enthusiastic man who sounded like he would be at home on Wall Street, with talk of new Paradigms, market behavior, and technology

"It's exciting," said Ricardo. "It's a historical, natural phenomenon to manage."

One of the most lucrative markets in this natural phenomenon is the trade in the services of young women.

HE SONG WAS "Goodbye Yellow Brick Road," by Elton John. In the long room 11 young women danced solemnly to the tune, turning and bending in unison while several of their friends watched from a doorway.

"If she is beautiful," said Eric Tiu, watching thoughtfully, "she makes \$1,500 a month." Tiu, a descendant of Chinese immigrants

to the Philippines, is a recruiter of young female entertainers. He finds them on the island of Mindanao, 500 miles to the south of Manila. He brings them to the city, feeds and houses them for about four months, teaches them to dance, then sends them to Japan for three- or six-month tours, earning a fee from club owners for each one, as well as a hefty fee from the workers themselves. At the time I talked to him, he had about 700 entertainers in Japan and another 500 in training in Manila.

Tiu's staff, which includes some trained choreographers, teaches the women to dance because that's required by the government. Though everyone knows that these entertainers are hired to provide Japanese men with girls to flirt with, the government has decided to discourage the trade not with prohibitions but with regulations, and one of those is that each entertainer must pass a test of dancing skills she will hardly need.

Many of the dancers were cheerful. One was

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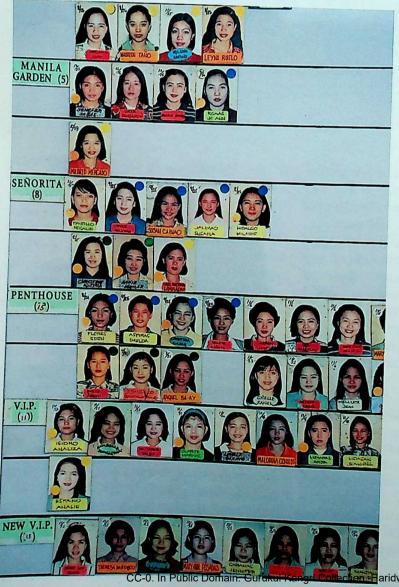
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Flight from the Philippines

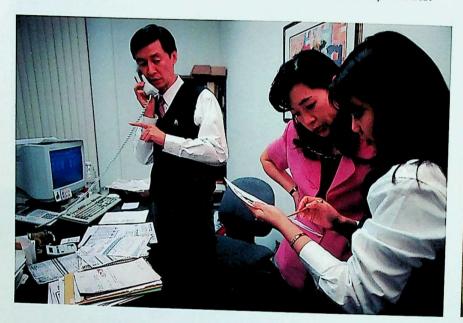
After their daily lessons—how to sing and dance, how to smile sweetly—women enrolled at a training facility in the Philippines (left) wait for a bus to their dormitory and for a chance to work overseas as "entertainers." Prior to departure, though, trainees must show they've got the right stuff (below). Training programs like this one, called Precise, provide the women with job contacts at clubs, most of them in

Japan, and with help obtaining visas. Precise also promises to monitor their welfare and whereabouts (below left). Human rights advocates say such programs do little to prevent the abuses of the sex trade, but Philippine officials insist the programs are helpful: Young women will migrate anyway, they say, joining 4.2 million Filipinos already working overseas; these programs can provide protection.



Being prepared for a new world

Chuck Chen, who came to the U.S. from Taiwan in 1979, transformed a \$2,000 investment into a ten-million-dollar computer company, which he now runs with his wife, Mei Fan (below, at center). "In the U.S.," Chen says, "you don't have to do something you hate just for money." Other Asian immigrants in California, determined to instill traditional values like loyalty in their children, get a hand from the Boy Scouts.





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on her tenth trip to Japan; on the proceeds from her work she had bought a "jeepney," which is a kind of informal Philippine bustruck, and was building a house for her family. "This is part of our adventure," she said. But when I asked another entertainer if she would want a future daughter to take this kind of job, she threw up a hand as if to ward off the idea. "No." she said. "No!"

Many of the newer students looked scared and lonely. The dance floor was a poignant scene: the sound of the music, the dancers' eyes blank, their minds focused on the skills that would be so unimportant, and the middle-aged entrepreneur looking at his precious cargo, calculating the dollar value of youth and loveliness.

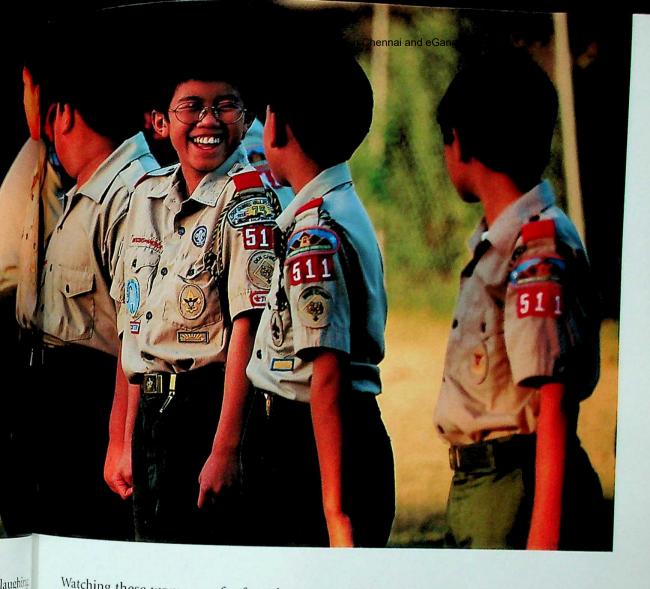
Leaving the dancers, we walked upstairs to his office, where Tiu was installing a large Toshiba home-entertainment system. We passed one of the bedrooms and glanced in the open door. It was a small room, with several women sitting and lying around at one end

of it, almost in a heap, reading and laughing "How many live in this room?" I asked him He shrugged. "Probably about 15," he said

where Tiu's dancers worked. It was low room in a basement, with stream ers hung across the ceiling, a glitter or tating in the center, booths upholstered red velvet, and Philippine flags and sentiment paintings of Philippine scenes on the walls. The club was called Music Supper We Serve, but the sandwich board outside were words the sandwich board outside were words and the painting of the Japanese booze.

The booths were full. There was a man each, flanked by one or two Filipino women they laughed and giggled together. Sometime they got up and sang in time to a karak machine. All the people I talked with assume that none of the women are expected go home with the men but also acknowledge that sometimes.

that sometimes they do.



Watching these women so far from home, I remembered what one recruiter (of domestics and factory workers) tells his clients to help them survive the first weeks on the job. "You will be so lonely," he says. "The only thing is to work yourself to sleep. And pray, pray, pray."

The money that entertainers and other working migrants send home is extraordinary. Young teachers in the Philippines make an average of \$150 a month compared with entertainers' \$500. The transfer of funds from migrants to their home countries, if lumped together, is one of the largest single movements of money in the world. In the Philippines it is an estimated eight billion dollars a year, almost three times the amount the Philippines receives in foreign aid. In all of Asia, money sent home by overseas workers totaled about 75 billion dollars in 1995, far more than the 54 billion dollars in 1995, far more in forci

None of the workers I met had signed papers saying they were going to return a single penny.

Yet they did send home a vast amount of money, whole national defense budgets' worth of money, because of love.

IGRATION TOUCHES raw places and deep places in many lives. One of those things, perhaps oddly, is the longing for home. This is one of the reasons immigrants so thoroughly enrich the cultures of the countries to which they move.

There's debate about what effect immigration has on the economies of the receiving countries. "Overall, society gains, but not everybody gains," says an economist at RAND, a Santa Monica, California, think tank. "People who directly compete with immigrants lose. The gains that do occur are smaller per person but affect a larger group of people." But there is no doubt that migrants' efforts to maintain a bit of home around them change the culture.

There are thousands of examples of this in the U.S. alone. One afternoon near Los Angeles I followed a group of Chinese lion dancers

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where the student body has undergone a massive makeover. In 1986, 52 percent of the students were white, and only 16 the months of the students were white. dents were white, an செற்ற நிரு இது முறியாக massive makeover. In 1986, 52 percent of the storage white, and 52 percent are white a massive mass are white a mass are white are white a mass are white a mass

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Gunn. But getting a smooth transition despite the language barrier," says principal Ken expl. But getting a smooth transition despite the language barrier," says principal Ken Gunn, But getting parents involved with the school remains a challenge. "In China," Gunn the advance in the advance of the police of the polic explains, "the educator has feeling parents involved with the school remains a challenge. In China, "the educator has feeling population of the control of t

Digitized by Arya Samaj Foundation Chennai and eGangotri

around a community. The dance was a raucous celebration that Chinese store owners greeted with little envelopes of money. And on another weekend morning I floated on an inlet in Long Beach with two Chinese dragon boats whose crews of immigrants and the very Americansounding children of immigrants were practicing for races later in the year.

These attempts to make the new place feel as comfortable as home don't always work. While I watched the dragon boats, a harbor patrol officer came over to tell the skippers that people in a condominium on the shore had complained of the drumming that set the pace for the paddlers. Since there were clamorous outboards racing up and down the same inlet and no one had complained of that noise, the message was clear to me: Someone did not like to have their view crossed by people from China.

Perhaps in part because of their awareness of an unwelcome mat, vast numbers of migrants, including many of Mexico's illegal visitors to the U.S. like Alejandro, never expect to move permanently. Though some labor migrants eventually adopt the new country, most return home. And among forced migrants—like the refugees in Tanzania—home is the most magical dream in the world.

HE BIG BOAT moved almost silently across Lake Tanganyika. It was after midnight. Burundi lay in distant, dark folds of mountain to starboard, and the Democratic Republic of the Congo, previously Zaire, was near at hand to port.

The land was dark, but the waters were alight. All around us floated what looked like candles, as if to show this vessel, burdened as it was with fears and hopes, the long path home.

The lights were the fishing lamps of Congolese fishermen, who use the glow to draw fish up to their nets. The boat was a 180-foot ferry called the *Mwongozo*. The cargo was 800 refugees from the recent civil war in the Congo that had changed their country's name.

Like almost everything about migration, this journey was bittersweet and scary. Peace had been declared in the Congo, but it was fragile. The people on the boat, who had fled brutal attacks almost a year before, were not sure what they were going back to. Some of them told me their choice to sign up for this voluntary repatriation, sponsored by the



UNHCR, was based simply on their hunger the refugee camps, where rations had been temporarily cut in half because of washed roads and railroads.

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"You might die in the Congo of a bullet," one refugee had told my wife, Suzanne, who speaks better French than I do. "But here your children will die of hunger."

Yet the jam-packed boat was cheeffel People stood in a crush of lines to get heafing plates of rice and beans cooked by company called Happy Caterers. Up near the bow, where belongings were piled high in the wrapped bundles, with a few handmade case with chickens in them, Suzanne and I take to a man named Jules, who had been a third year medical student before the war chasely him to Tanzania. With him was a friend Patrick, who had been studying architecture



Their roads led to Rome from the Philippines. Eric Zulueta came, via Chicago, with the U.S. Army. Michelle Salanguit, attended by Eric's cousin, migrated to Italy to join her mother. The couple now reside in Texas. "I'm American," says Eric, "but I'm part of another culture too."

Both were on board with their wives and kids. "When we left," Patrick said, "there was a war. Children were running away along the shores of the lake. But the war is over now, though we don't know if our houses are still there, I was happy to leave for Tanzania, but I'm very happy to go back now."

"At least now," Jules said, "we'll be able to work and to study."

"What's the first thing you're going to do?" Suzanne asked.

"Get something to eat," Patrick said. In the middle of the night the boat anchored just off the Congolese shore, still accompanied have the nied by the lamps of the fishermen. When the

anchor dropped, a cheer rose into the darkness. After the cheer faded, someone on the ferry gave a single whistle. It was like a long birdcall, testing the night for friends. From one of the candles on the lake, a whistle came back.

Near the place the boat anchored to wait for the morning's disembarkation was a town named Baraka. I didn't know whether to take the word's meaning with irony or hope, but at least it reminded me of the way migration has woven its colors into every pattern of our lives. The word is Arabic, brought to the Congo long ago by traders. It means "blessing."

Learn more about human migration at www.national geographic.com/features/2000/population/migration.

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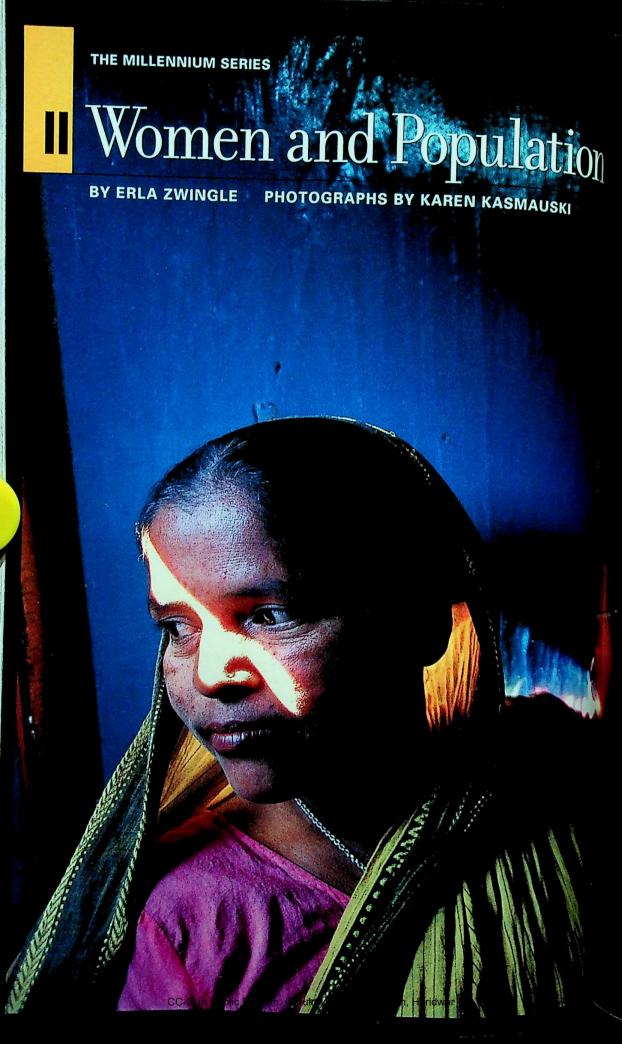
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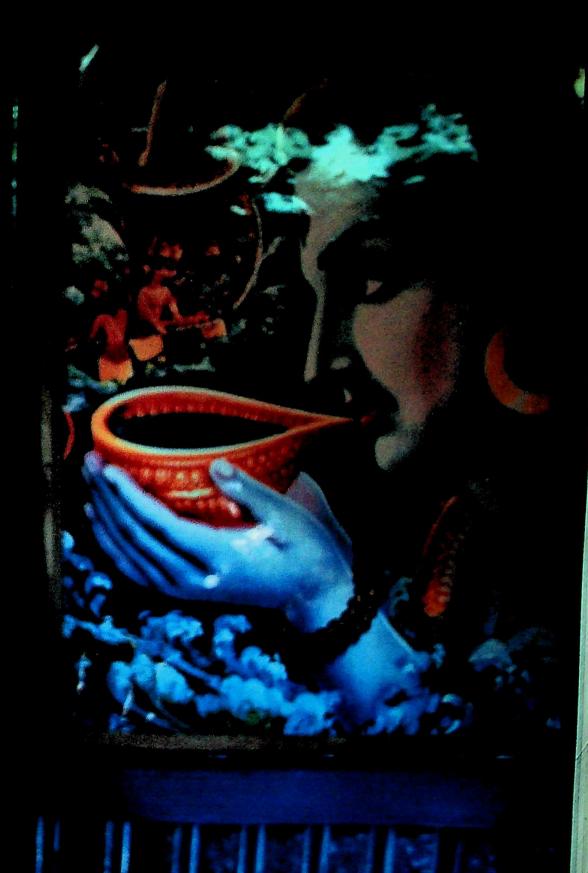
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■ Architect of her own happiness, a Bangladeshi widow stands in the house she built for her family with money from a bank for the poor. Worldwide, new opportunities are allowing women to choose smaller families and richer lives.

"Don't look at people like an ant heap

A CERTAIN NOVEMBER DAY an obscure woman in Iowa gives birth to seven babies; we marvel and rejoice. On the same day an obscure woman in Nigeria gives birth to her seventh child in a row; we are distressed and appalled.

In Brazil a mayor sees his town shrink by two-thirds. Determined not to lose subsidies tied to population, he bans all contraceptives. In Bangladesh the government, determined to stem the tide of births, offers to sterilize women for free and throws in a new sari as a gift.

In Kenya a woman keeps trying for a son because her husband asks, "Who will hold my head for me when I die?" In the United States an unmarried teenager looks at her infant daughter and says, "I don't really know what I was doing. I thought I was in love. I thought it was this great thing, but it was stupid."

Population: We know it's a problem. In fact most of the problems facing individuals, families, communities, and nations are affected by the quantity of humans sharing the planet. But if the problem were only numbers, these stories would have no power to touch or perplex us. Nor would we race to bring food to famine-stricken countries, or blanch to read of newborn babies being thrown into trash bins, or fall silent upon hearing of the pregnant mother who refused cancer treatments that could damage her baby, gave birth, and died. Even as some fear for our species' survival, we instinctively sense mysteries that transcend statistics. "Don't look at people like an ant heap,"

predicted mass catastrophe as a result of overpopulation. So far, events have not turned out quite as he supposed they would, yet the brutal probabilities he described continue to darken some views of the future. Today 98 percent of "The world is going to hell," as one observer

bluntly paraphrased the common fear, "if the people don't stop breeding."

True, the numbers give pause. Today the are almost six billion people in the world. the next 15 years annual increases will probable bly remain just over 80 million (or one billion every 12 to 13 years). The United Nations ev mates that by the year 2050 there could be from 7.7 billion to 11.2 billion people in the work

Will this be too many? It is difficult to predict, as even Malthus would have seen by non-Predictions often impel changes in the ver behavior that inspired the prediction. Provide ing enough food, of course, is paramount But what about fresh water? Forty percent of the world population faces water shortages a

one expert urged. "These are individuals." Two hundred years ago Thomas Malthus

population growth is in the developing world.



Freelance writer Erla Zwingle lives in Venice, Italy, a country in which the falling birthrate is a serious concern. Photographer Karen Kasmauski, a mother of two children and a veteran of 16 Geographic assignments, also focused on human migration for this issue.

one expert urged. "These are individuals."

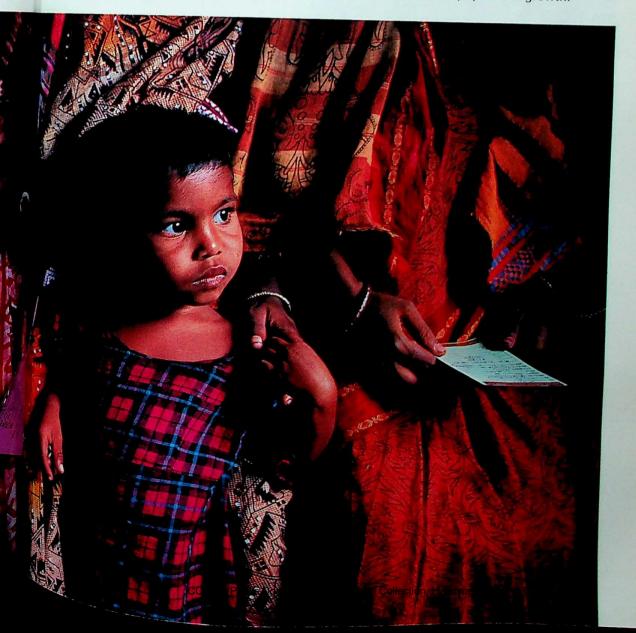
some time during the year. What about jobs? There is already an increasing shortage of those too, and according to the Population Reference Bureau masses of unemployed people form "a social and political time bomb."

But there has been dramatic progress over the past 30 years. Birthrates have dropped in many developing countries (including China and India), and the number of children born to each woman has fallen on average from six to three. This is the result of remarkable changes on three fronts: contraception, health care, and culture, the strongbox in which our sense of what we can do is locked.

Contraception has been the key. The number of women in some developing countries using contraceptives has risen to more than 50 percent. "There isn't any place where women have had the choice that they haven't chosen to have fewer children," says Beverly Winikoff at the Population Council in New York City. "Governments don't need to resort to force."

Yet some 200 million women become pregnant each year. Half of these pregnancies are

Soon to have a sibling, an only child nestles in her mother's sari at a clinic in Bangladesh. Nurses provide checkups and offer advice—starting with "space your children." Longer gaps between births mean healthier mothers and babies and slower population growth.

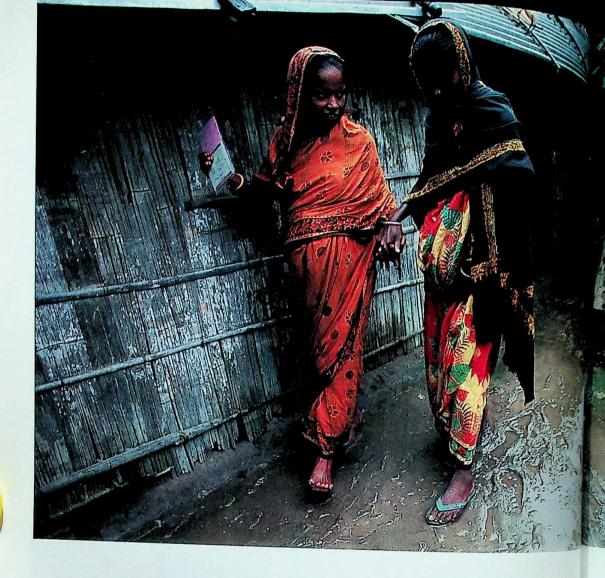


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unplanned, and a quarter are unwanted. Unwanted children are often neglected, abused, or abandoned. They receive less food, medical care, and education than wanted children.

More than half a million women die each year from causes related to pregnancy, often the result of poor health, lack of medical care, and having babies too close together. Seven million infants die each year because their mothers were not physiologically ready for pregnancy or lacked obstetric care. Millions of women and men resign themselves to this reality. But with the chance to plan their families, they are beginning to see a way to re-imagine their future. "People are desperate," one woman said, "to control their own destiny."

N BANGLADESH dawn rises over banana groves and palm trees, the emerald expanse of rice fields, and pools where women in vivid saris immerse themselves, drenched in the golden light. Here the problem of overwhelming numbers seems

obvious. Bangladesh is the ninth most populous nation on Earth, and, with only 52,000 square miles of land, it is one of the densest. It is also one of the poorest.

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Today Bangladesh is praised as a population success story. In 1990 its birthrate was at unbridled 4.9 children per woman (which is unchanged, would have doubled its population by the year 2015). The rate is now 3.3, a fact that has astonished those who believed the country's population would drop only after chronic poverty and illiteracy were overcome.

Much of the credit goes to two of the main organizations that help the poor: the Dhake based Grameen Bank, with its innovative program of "microcredit," or small loans, and the Bangladesh Rural Advancement Committee (BRAC), with its nationwide network of village clinics. The work of BRAC and Grameen made it possible for millions of women and the children who once could hope only for survival to begin to dream of progress. Mosammus Anowara Begum is one of them.

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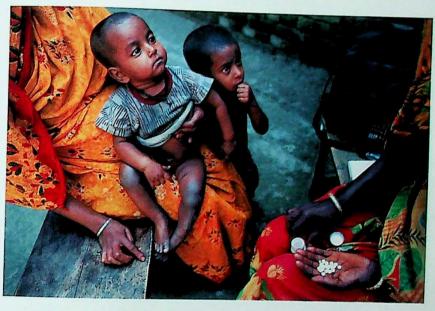
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Woman to woman

Pledged to bear no more children, a volunteer with the Bangladesh Rural Advancement Committee counsels a pregnant woman in Shoal village (left) and dispenses antibiotics for a mother's sick baby (below). She also discusses family planning. Contraceptives distributed by such workers helped lower Bangladesh's birthrate from seven children per woman in 1975 to fewer than four in 1995.



Chamurkhan village isn't very different from the 68,000 other villages in Bangladesh: an assortment of one- or two-room houses with corrugated metal roofs and walls of palm matting, clustered around small common areas of beaten earth. As the morning light begins to spread through the trees, a rooster crows; a baby gives a small, fretful cry; a dog barks. Someone nearby hawks and spits. Then the phone rings.

Anowara Begum has the only phone in the village; it's a Nokia cellular phone. She bought it with a loan from the Grameen Bank, and she makes money with it. Instead of selling milk or eggs, as many of her neighbors do, she sells telephone calls at 4.6 taka (about ten phone bill and weekly loan installment and seep some profit too.

"Every week I make 300 taka [\$6.50] from three phone," she says, "and I repay 160 taka. In parts of Bangladesh an illiterate widow with

several children could be destined to beg or even turn to prostitution. But once the loan is paid off, Anowara Begum stands to net an average of \$2 a day—more than \$700 a year—in a country with an average annual per capita income of about \$250.

Since its launching in 1976, the Grameen program has loaned more than two billion dollars, in amounts averaging only \$180, to more than 2.1 million destitute women.

"We find that when women start borrowing, it benefits the whole family," Mohammed Abul Hossain, a senior officer at Grameen, tells me. "Her children become important, the family's welfare becomes important." One recent study in Brazil showed that income controlled by the mother had a benefit on her children's health that was almost 20 times greater than income controlled by the father.

Sharifa Akhtar Shikha, Anowara's 20-yearold daughter, studies Islamic history at Dhaka's Jagannath University. "If my mother hadn't gotten the loan," Shikha says, "it would have been impossible for me to go to the university. But she wanted me to have a higher education."

Why? Anowara smiles. "For the future," she answers. "She will be independent and have more income. And she'll be happy also."

When people can start making decisions about their lives, they also start making decisions about the size of their families and vice versa; family planning within Grameen families is twice as common as the national average. Surveys have also found a strong link between education and family planning.

But Bangladesh still has a high death rate of babies and mothers. Here females die earlier than males (the opposite of the biological norm), due in part to severe malnutrition and risky pregnancies, often too close together.

To help improve health care, BRAC has founded clinics throughout the country. "Many more women want contraceptives now," said Mergina Khatun, a village health worker in Mymensingh district. "They see that if a mother has fewer children, she can give them better care. And her health will be better."

What if a conservative Muslim leader tells Mergina that contraception is against the will of God? "I say that God also told us to be responsible for our families."

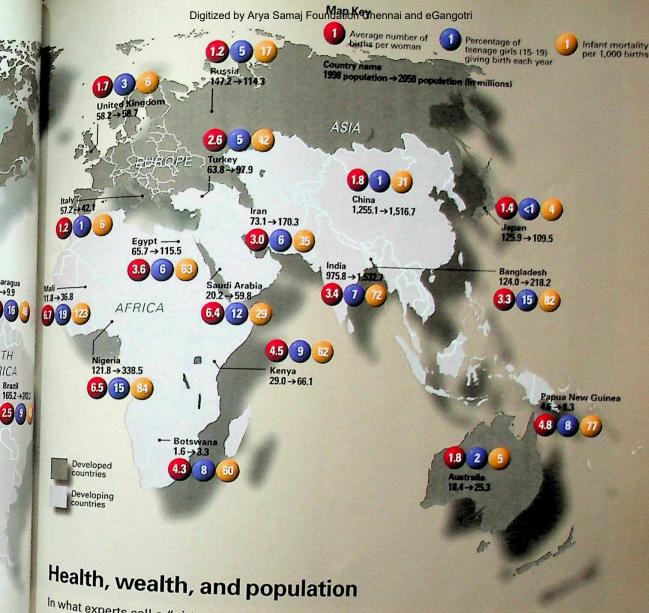
In the BRAC health center in the town of Mymensingh, the nurse is counseling a few of the 800 women who visit every month. A thin young woman, three months pregnant, sits listlessly by the desk. She tells the nurse that she has been suffering from morning sickness and has an intermittent fever. She is 20 years old and has been married three and a half years. This is her third pregnancy; she has already suffered one stillbirth and one miscarriage. Contraceptives could have helped her delay these pregnancies until her health improved.

The nurse advises her to take full bed rest, eat extra food, and do no heavy work. None of this will be possible for her. The nurse prescribes an antihistamine spray and an analgesic for the pain and fever. The girl's gray-haired mother-in-law crouches on the floor, leaning against the wall, waiting silently.

Loans and contraceptives continue to improve the lives of Bangladeshi women and their children. But sadness still inflects the lives of even healthy families.

"I have three daughters; the youngest is just a year and three months old," says Firoza in





In what experts call a "virtuous cycle," family planning leads to healthier women, since mothers avoid early, late, or closely spaced births. Healthier women have healthier children. And fewer child deaths lead to fewer births, as women stop believing that they must have many babies for a few to survive. In the past many concluded that economic development was the best contraceptive. Now, backed by studies showing family planning is the most effective means of lowering births worldwide, experts say, "Contraceptives are the best contraceptive." Yet development opment and its benefits, especially better education and health care, remain essential. Such advances raise demand for family planning, persuade Young couples in poor countries to tries to postpone childbearing, and encourage

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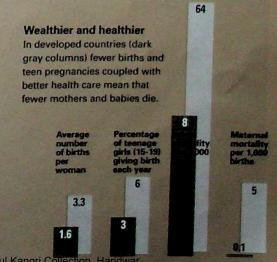
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the treatment of women as men's equals. According to the nonprofit Population Council in New York City, "One can promote a smaller world by promoting a more just world."

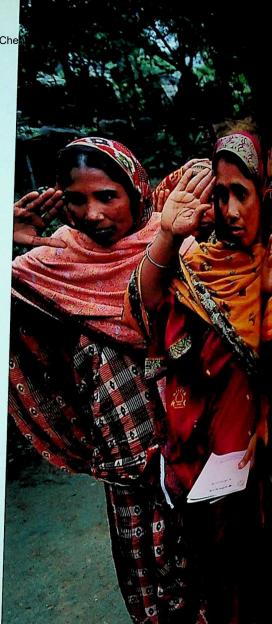


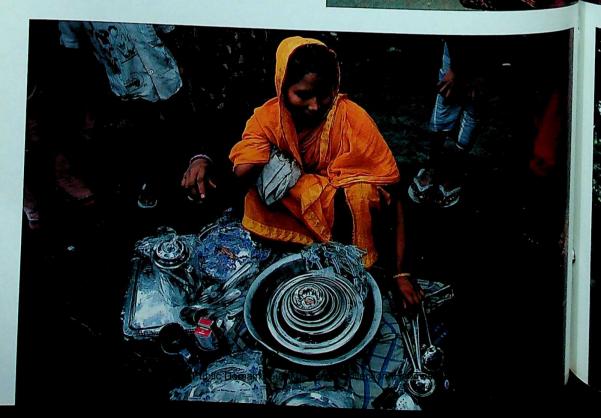
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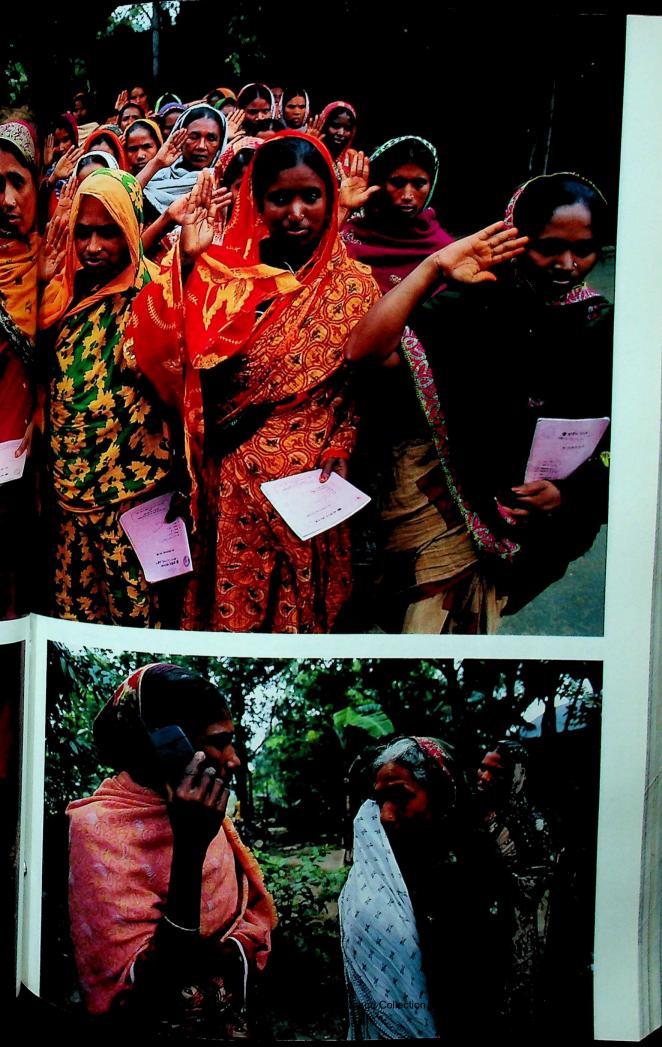
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Army of entrepreneurs

Saluting the future, women meeting near Dhaka to repay loans acknowledge the loan officer from Grameen Bank, who freed them from lives of powerlessness and isolation. "We shall plan to keep our families small. We shall keep free from the curse of dowry. We shall not practice child marriage"—so runs the creed Grameen clients, who are 95 percent female and 100 percent poor, recite as a promise to break from traditions of poverty. Launched into business with a small loan, a woman travels from door to door selling cookware (below). Anowara Begum (below right) used a loan of \$390 to buy a cellular phone, which fellow villagers pay to use. Soon after the death of her husband, Anowara hears from her brother in Malaysia while their mother weeps. For birthrates to keep falling, experts say women must be offered opportunities beyond motherhood and given the authority to choose whether to bear children.









Taldighi village. "My husband is disappointed. Now he is saying he didn't want any more children. Two would have been better, he says, since the third one was a girl."

"I had twin baby boys," her neighbor, Alefjan, tells me. "They died of a respiratory infection, one when he was seven days old and the other when he was 14 days old. My husband told me, 'We don't need to go to the hospital—they don't have drugs for children this small.' And I believed him."

OMEN AND POPULATION," repeated Beverly Winikoff at the Population Council when I told her my topic. "It sounds like you're treating women as the disease vector." What about men?

The sun rises over Nairobi, gilding the dusty parks, the battered streets, the chaotic, makeshift markets. Kenya used to have one of the highest birthrates in the world, but in the past 20 years it has shown one of the steepest declines in all Africa. As in Bangladesh this is due

in large part to massive education campaigns more clinics, and inexpensive contraceptives. But Africa, which still has the highest birth rates in the world, remains profoundly centered. "A person who doesn't have children's looked down on," a woman explained, "because that person is incomplete in the society."

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In much of the world men have often been the major objectors to family planning. Some do so on the basis of religious beliefs others want to demonstrate their virility. Man believe that only the fear of becoming presenant will keep their wives faithful. And there are misunderstandings: "I used to hate family planning," a man told me, "because I though it meant that people shouldn't have children.

Yet as men struggle to provide for the families, some admit that smaller families at better. To help them become more involved family planning, male-only clinics have begun to appear in Kenya, Ghana, and some South American countries. And a few pioneers, over coming the common fear that sterilization



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Early parenthood

Seven months a mother, Jill Crisler, 16, fixes a bottle for her son, Trenton, before leaving for Northeast High in Lincoln, Nebraska. Like many teenage births, this one was unplanned. "It's not a mistake," says Jill. "I call it a surprise." Unlike most unwed fathers, Luke Smith stays in his son's life, hurrying from his job to his new role as Trenton's playmate at the school day care (below).



make them impotent, are choosing vasectomy.

Philip Njuguna is pastor of the Nairobi Calvary Temple, a Pentecostal church in a poor neighborhood. At 37 he is a small, compact man with a friendly, intelligent expression. I first meet him in the male-only suite of the Marie Stopes Clinic downtown.

The main waiting room is full of women and children watching television and reading magazines. The rooms next door are for men only. The yellowish walls bear a few modest posters: "Plan your family now—your children's future depends on you." "45 million men around the world have had a vasectomy."

"My father had just eight acres," Philip tells me. "It was an average-size farm but not enough cup of tea. No lunch. Poverty eats you every day. "What made me decide to have a vasectomy raise," he continues. "My wife was taking pills, my wife? I'm her partner. I'm there to help her.

That's what the Bible says. So I read about vasectomy. The only side effect is that you can't have children anymore"—he smiles—"and that's the side effect I wanted."

To their credit many men worry about the possible side effects some contraceptive methods may have on their wives. Then again, studies show that men are generally reluctant to use methods that directly involve them—withdrawal, abstinence, condoms, and the rhythm method. As for vasectomy, says clinic counselor Patrick Musyoka in his gentle voice, "The stigma is still there."

Men are the point at which family planning leaves the realm of mechanics and enters the mysterious territory of behavior. Contraceptives themselves are simple—it's the users that are complicated, caught up in the volatile dynamics of human relationships. "Family planning came to Kenya through health programs for women," Godwin Mzenge, a program director, tells me. "The assumption was that women would discuss with their husbands

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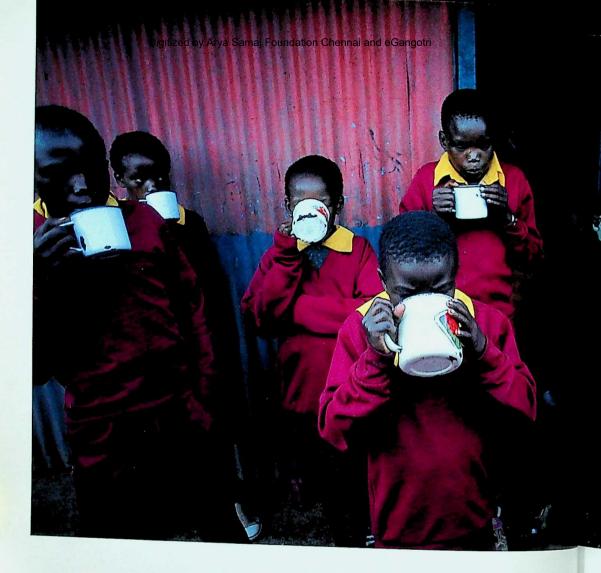
Premature parents, mothers at Lincoln High School gather at lunch as part of a student-child program that helps them graduate. The U.S. has the highest teenage birthrate in the industrial ized world. Adolescent தந்திரைகள்ளைகள்ளைகள்ளனர்களின் மாகியில் மாகி

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growth. Rather than stressing either abstinence or contraceptives alone, successful prevention birth control," says Susan Powers Alexander, Grund Grand Gran

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what they learned. But now we know that communication between them isn't that common."

"We encourage the women to keep discussing," says Rose Ngahu, a nurse. "It takes a lot of force of character to resist the husband."

N LINCOLN, NEBRASKA, a crisp autumn morning spreads across the prairie, over the flags snapping in front of the state capitol, over the football fields ready for marching-band practice after school. In the half-light students are arriving for class at Lincoln High School. They carry the usual teenage stuff: books, musical instruments, backpacks. Some of the girls are also carrying their babies.

The U.S. has the highest teenage birthrate of any industrialized nation. Since 1960 the rate has tripled among unmarried females age 15 to 19. According to the Alan Guttmacher Institute, four in ten American girls become pregnant at least once before they reach 20; most of these pregnancies are unintended.

We think of Lincoln as the real America. And

it is, but not always in the way we mean. The like to have a baby," said Tonya, a pert 12th grader, "but not now. Too many of my friends have babies: Mindy, Janet, Penny, Becky, Str. Ann, April. . . . "

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This is bad news, for a number of reasons First, there is sheer quantity: By the year 2000 there will be more adolescent girls in the world than there have ever been: 400 million poised to begin having children. If they were to delay their first baby by five years, it would mean billion fewer people by the year 2100.

Second, there is the quality of those lives. Of the nearly four million babies born each year in the U.S., nearly one out of eight is born to a teenage mother. When a girl under has a baby, problems mount for everyones have used to go on welfare. (In 1995 the government spent 37 billion dollars on welfare by a teenage mother.) Emotional immature can lead her to abuse her baby; it can be hard



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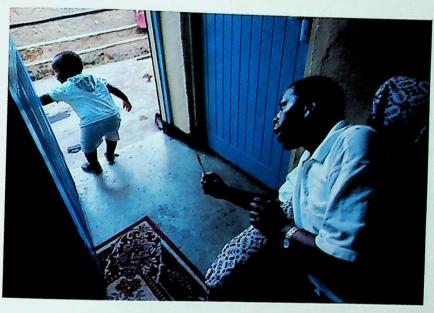
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Smaller is better

Dressed in school uniforms their mothers struggled to buy, Masai children drink a breakfast of tea in the doorway of a house in rural Kenya. In Nairobi, Philip Njuguna, a pastor, watches his third child and only son (below). Njuguna underwent a vasectomy after the boy was born. "When the family is small, whatever little they have they are able to share," he says. "There is peace."



overcome the stresses of pregnancy and labor on a body that hasn't finished developing. "It's a myth that because they're younger, they're healthier," one woman told me. "What teen do you know who eats right?"

Her baby also may very well have difficulty: Infants born to teenage mothers are at higher risk of low birth weight, prematurity, and still-birth than children born to women age 20 to 24. They also tend to have lower test scores and higher rates of physical and psychological problems. Sons of teenage mothers are more likely to serve time in prison. The state of Utah mother saved the state \$400,000 in various many of the girls only know that they are oversaid. I didn't feel shame," one of them

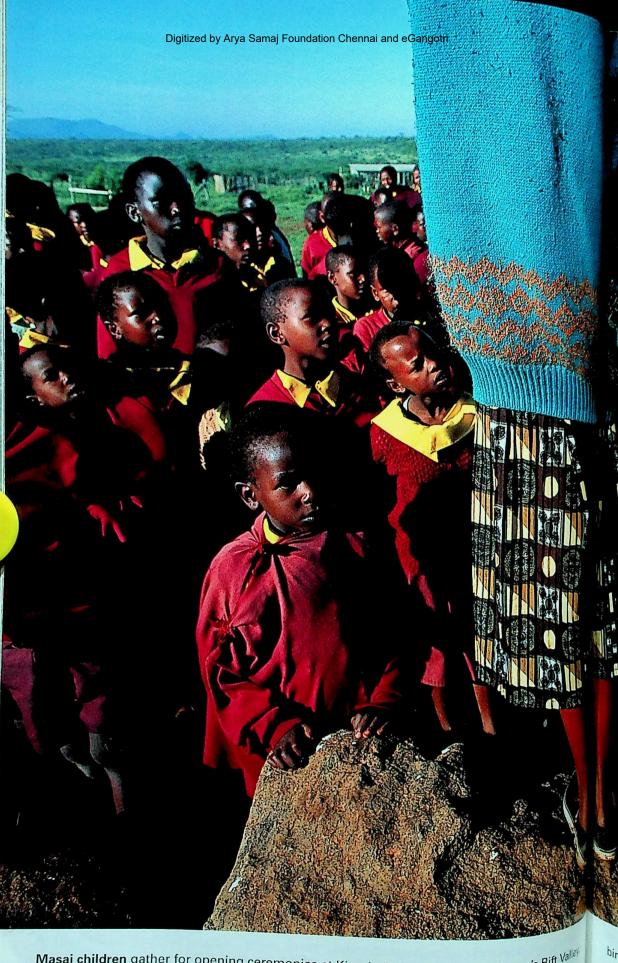
In 1993 some of the staff at Lincoln High opened a child-care and learning center at the east High—and their colleagues at North—avow that their first priority is to

make sure the girls graduate. "We want the girls to be successful," says Karen Poore, a teacher at Northeast. "Whatever will help them complete their education, we advocate."

There was resistance. "Some people didn't want Lincoln High to be known as 'the pregnant school,' "says Ann Irvine at the public school district office. "There was still the shame factor. We had to get over that." And objections came from those who were convinced that a day-care center would be seen as encouragement to be promiscuous. "The girls just laugh," says JoAnn Bartek, who teaches family and consumer sciences. "They say, 'Oh yeah, that's really what we were thinking: They've got this really neat day-care center; I think I'll go get pregnant."

As for those who maintain that the girls shouldn't be in school, according to Bartek, the girls say, "Well, where should we be? If we don't get our high school diplomas, we're going to be on welfare. We're going to be homeless." One study found that almost 60 percent of

WOMEN AND POPULATION CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar



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teens who became pregnant dropped out of high school. At Northeast and Lincoln High 80 percent of pregnant teens are graduating.

I meet some of these teens at the child-care center at Lincoln High. The room is spacious and cheerful, full of toys and cots and intensely clean. Several girls are here on their lunch break, crouched on the floor playing with their babies or talking with the assistants and each other. A few sit quietly, nursing. The mothers look more like older sisters.

At 3 p.m. Mandy Brehm comes to pick up her eight-month-old daughter, Juliana. Mandy is 16; she has long brown hair, green eyes, and a pretty, round face. She's named in *Who's Who Among American High School Students*. When we get home, her mother, Diane, and her younger brother, Jared, are there.

There is pizza for dinner. As we eat, Diane recalls the day she learned her daughter was pregnant. Mandy couldn't find the courage to tell her; instead she left a note on her mother's bed. "It said, 'I'll never be the daughter you wanted. This is the worst day of my life. But I don't want to kill the baby.' I cried for about two hours. Then I called her at school and asked if she wanted to come home."

Many girls do not have the support or the determination that Mandy did. Fifty percent of abortions in the U.S. are sought by women younger than 25.

"My own thought," says Beverly Winikoff at the Population Council, "is that most people wouldn't use abortion as a first choice. But they're pregnant, and they need not be."

What will Mandy tell Juliana when she grows up? "Not to have sex," she replies. "'Cause it's not worth it."

Mandy will probably be the only person telling her that. "We bombard kids with sexual messages, but we don't teach them how to process them," says Susan Powers-Alexander, a director at Planned Parenthood in Lincoln. "We don't teach kids to decipher that they're using sex to sell cars, perfume, pineapple."

The influences on adolescents are powerful and pervasive: movies, advertising, music, peer pressure. The girls face life with a wild assortment of mismatched traits: ignorance, bravado, curiosity, delusions of invulnerability. The reasons for teen pregnancy go on. Many teen mothers are children of teen mothers. Alcohol and drugs undermine the ability to



make clear decisions. Older boys can dazzle of dominate: Over half the males responsible for teen births are 20 or older. Early sexual abusc cripples the capacity to say no; one study reported that 48 percent of high school students who had been pregnant were once set ually abused. And there is fear of losing love.

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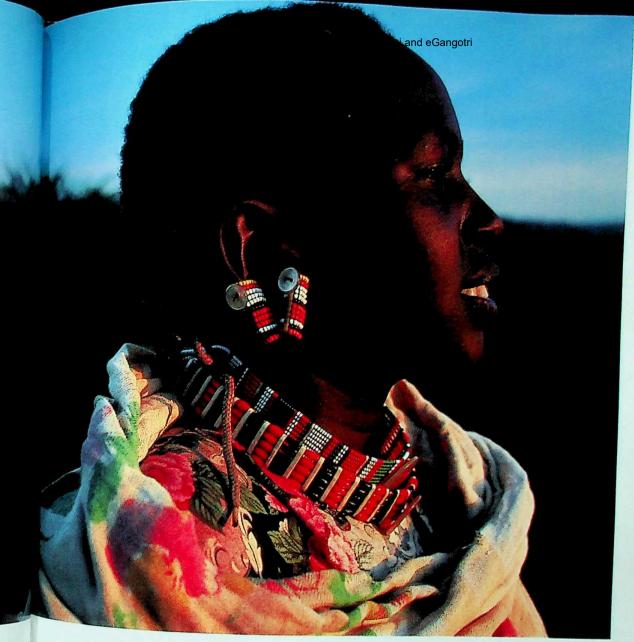
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"Part of the reason I was so reckless was I didn't like myself at all," Mindy Latzel, is tells me. "He was 22 at the time. He made me feel good about myself, telling me how pressel was. But I guess it was a bunch of lies."

OW MANY CHILDREN should we have
How far apart?" Stan Bernstein
senior research adviser at the
Population Fund, asks rhetorical
"How should we educate them—concentrated
a few and hope they'll take care of us?" The



Married but without children, a Masai teenage bride looks forward to her first pregnancy. While many women's lives are still dictated by circumstance, more and more now enjoy choices. In their hopes, fed by new possibilities, the future is born.

discussions are happening more and more. The World Health Organization estimates that sexual intercourse occurs a hundred million times a day. Yet despite the great strides of the past three decades, millions of couples who want to use contraception don't have access to it. Many developing countries, faced with shrink: crisis and political uncertainty, are shrinking their financing of family-planning programs. Some foreign donors have also cut

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back on aid—the U.S. by one-third. In Kenya a man says, "When my wife didn't want to have more than three children, my In D lave more man ...
In D start told her, 'You're just lazy.' "

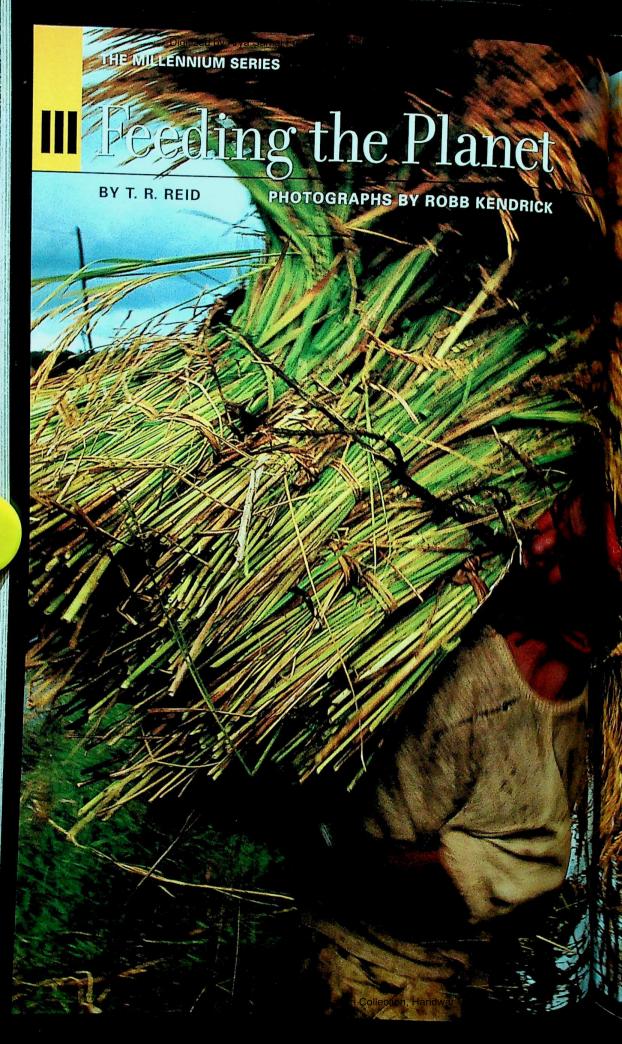
In Bangladesh a woman says, "Two children

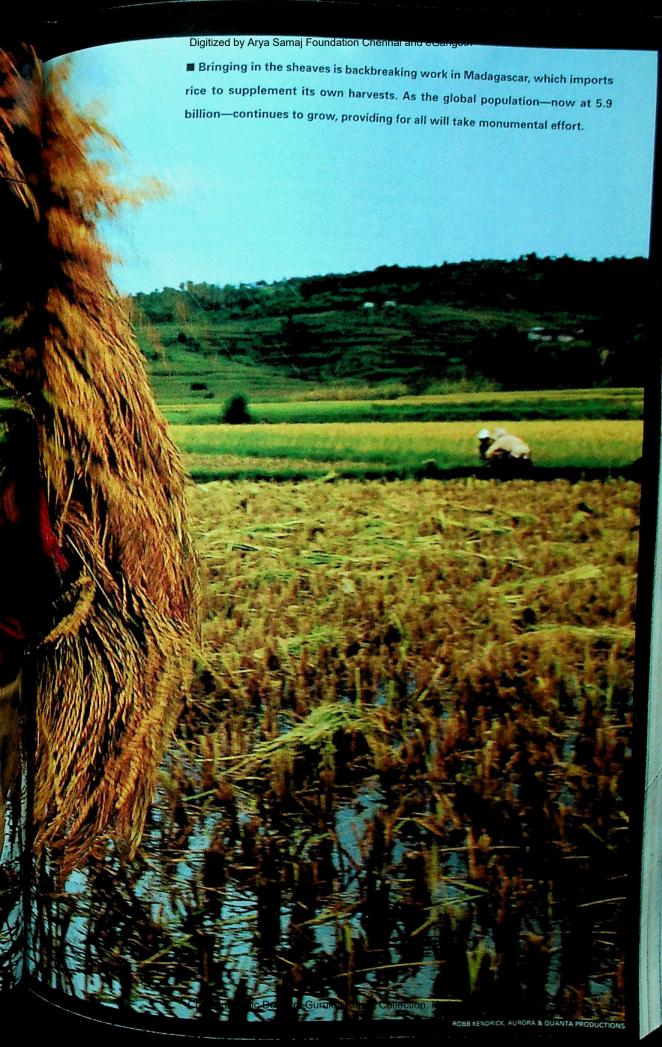
are enough. Because if you have more, you can't raise them as human beings."

In the U.S. a 16-year-old father looks at his infant son and says, "I'd probably be locked up in some juvenile hall if he wasn't here. He's changed me for the better."

The sun rises every morning on more than a quarter of a million newborn babies. A few of them may change the world; all of them will change their mothers and fathers. They don't belong to the ant heap. They belong, for better or for worse, to us all.

Erla Zwingle reports further on teenagers and pregnancy at www.nationalgeographic.com/features/2000/





Can the planet produce enough food to fee

increase by 230,000 Hungry people. In 1998 about 137 million human beings will be born, and some 53 million of us will die. That amounts to a net population gain of 84 million-more than 230,000 additional residents of the Earth every day of the year. Many of these newcomers will suckle their meals from a mother's breast for a year or so, but after that it will be up to Mother Earth to provide them food and drink. Our fragile, overextended planet and its hardworking human population will have to feed those 230,000 hungry people day after day for

THE DAY YOU READ this, the

population of our planet will

These sobering numbers raise two crucial questions: Can the planet produce enough food to feed the 5.9 billion human beings alive today and the billions more who will be born over the next few decades? And if we do manage to produce enough, do we have the wit and the will to distribute the Earth's bounty to all those who need it?

and the day after that.

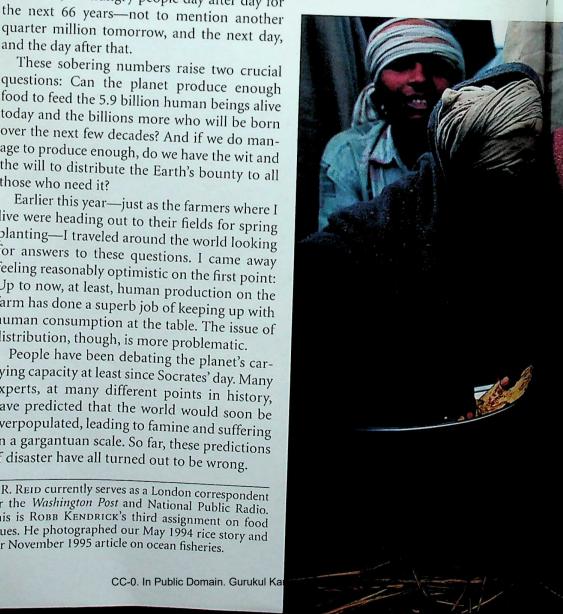
Earlier this year—just as the farmers where I live were heading out to their fields for spring planting—I traveled around the world looking for answers to these questions. I came away feeling reasonably optimistic on the first point: Up to now, at least, human production on the farm has done a superb job of keeping up with human consumption at the table. The issue of distribution, though, is more problematic.

People have been debating the planet's carrying capacity at least since Socrates' day. Many experts, at many different points in history, have predicted that the world would soon be overpopulated, leading to famine and suffering on a gargantuan scale. So far, these predictions of disaster have all turned out to be wrong.

T. R. Reid currently serves as a London correspondent for the Washington Post and National Public Radio. This is ROBB KENDRICK's third assignment on food issues. He photographed our May 1994 rice story and our November 1995 article on ocean fisheries.

Exactly 200 years ago, when the world's po ulation was nearing one billion, the Brit economist Thomas Malthus offered the no famous statement of the basic dilemma. Polation, he said, must increase, because "thep sion between the sexes is necessary and w remain." But food supplies could not poss increase as quickly: "The power of popular is infinitely greater than the power in the earl to produce subsistence for man."

Modern-day Malthusians have been, if a thing, even bleaker. A quarter of a centur ago Paul Ehrlich, a leader of the global en ronmental movement, warned that our wor was on the verge of "famines of unbelieva".



the billions who will be born in the future?

proportions." The population was about 3.5 billion, which Ehrlich believed was the limit. Feeding six billion people, he wrote in 1976, "is totally impossible in practice."

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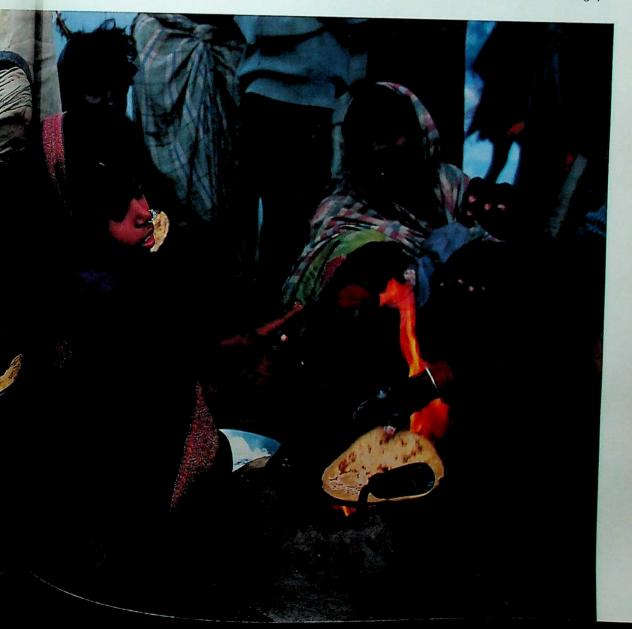
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Next year the world's population will reach six billion—and human beings overall are better fed than ever before. Thirty years ago, according to the United Nations, the global food supply represented 2,360 calories per person per day. By the mid-1990s total food supply had increased to 2,740 calories per

person per day. Supply will continue to grow faster than population at least through 2010, the UN predicts.

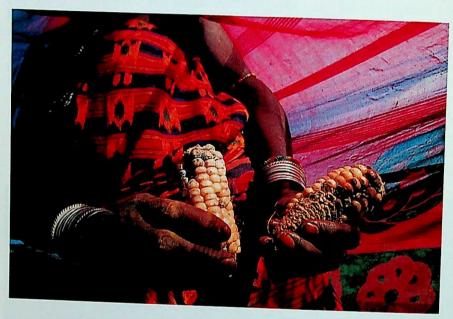
The big jump in population in the second half of this century has created much greater demand for food. But supply has increased even faster than demand, and the price of staple foods has fallen dramatically. Over the past 40 years the price of wheat, in constant dollars, has declined by 61 percent; the price of corn has dropped 58 percent.

A hot meal means little more than bread for migrant workers in India. Though farms worldwide produce enough to feed everyone, hundreds of millions cannot afford a balanced diet. With greater numbers competing for food in the future, rising prices may leave many more hungry.



Improvement plan rained out

Freak rains flooded the usually parched land near Marsabit, Kenya, last year, stunting a drought-resistant strain of corn donated by Food for the Hungry, a U.S.-based aid organization. Like many in the developing world, farmers here have little money to buy such seed varieties—or most other components of the green revolution. Ready to try again, they struggle to plow a soggy field the old-fashioned way.





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HE ABILITY TO PRODUCE more and more food each year stems from one of history's most important inventions: the farm.

For the first hundred millennia or so of our species' existence, a person's next meal depended on which nuts shook loose from trees or which wild animals could be clubbed. But somewhere around 8000 B.C. Neolithic man—actually, some scholars say, it was probably Neolithic woman—began farming. Women figured out that if they saved some of the grain they gathered, scattered it on the ground and waited around a few months, more grain would spring up.

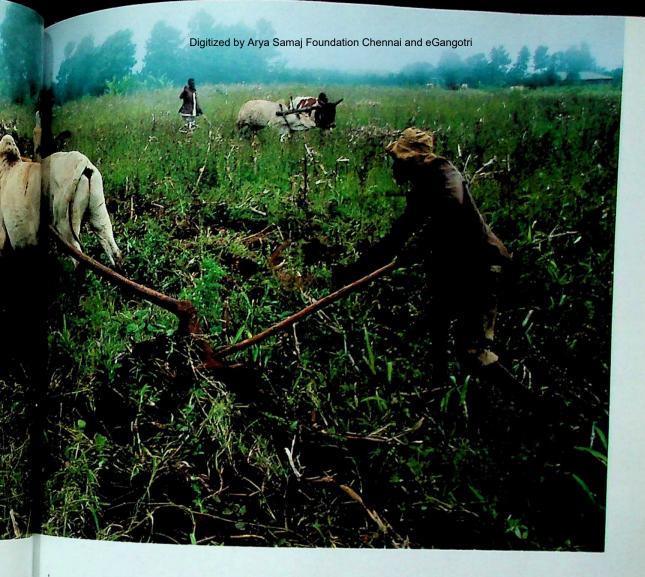
The first significant agricultural crops were grasses: barley, wheat, rice, etc. These grains quickly became the staff of life—so valuable that almost every early religion known had a specific god who could be invoked to guarantee the grain harvest. In Western civilization the most important grain deity was the Roman goddess Ceres, which explains why

the Wheaties, Corn Flakes, and Rice Krispa we eat in the morning are known as "cered The ancients were obviously onto something because even today more than 70 percent of a cultivated land is devoted to cereal grain.

These crops provide the bulk of human nutration; most of the calories we consume conform grain or from eating animals raised of feed grains.

Traders and travelers transplanted loc crops around the world, and these green emigrants often flourished in their new home a fact obvious to anyone who has travel through the central plains of North Americand seen there oceans of waving wheat plant native to the valleys of the Tigris are Euphrates Rivers in what is now Iran, Ir

The agricultural revolution was accomplied by another fundamental change in the pattern of life: The birthrate came to extend the death rate, and world population a steady growth. Of necessity, agriculture



became the dominant human endeavor—and still employs nearly 50 percent of the world's labor force.

To produce more food, humans expanded the amount of land under cultivation and found ways to increase the yield from existing fields. For the most part this has been a success story. But each breakthrough has had undesirable by-products.

Around 3000 B.C. the invention of the plow greatly increased the output from a given plot of land. But plowing left soil vulnerable to erosion, prompting the agriculture historian Daniel Hillel to observe that "the plowshare has been far more destructive than the sword." The industrial revolution enabled a single farmer to cultivate more land—with proporlionate increases in energy consumption and air pollution. In the 1960s the new plant varieties and agrochemicals of the green revolution yielded huge increases per acre, but many fertilizers and pesticides left toxic residues behind. Despite innovations—and sometimes

because of them-soil and water degradation threaten agricultural output worldwide.

Still, improvements in agriculture have kept food supplies high enough to meet the growing world demand. What Malthus called "the power of population" has been matched and exceeded by the power of innovation. Global food production today is sufficient to provide everyone on Earth an adequate diet.

And yet hundreds of millions of people do not get the 2,200 calories per day generally accepted as the nutritional bottom line. About 20 percent of the developing world's population is chronically undernourished; 30 years ago the percentage was twice that high, so we're making progress. But why must anyone go hungry?

The problem is not production but distribution. Local food supply often has little to do with natural conditions. Some of the best-fed people live in countries-Japan, for examplethat don't have enough land to grow their own food. Some people who live in green meadows washed by regular rainfall are hungry. A major

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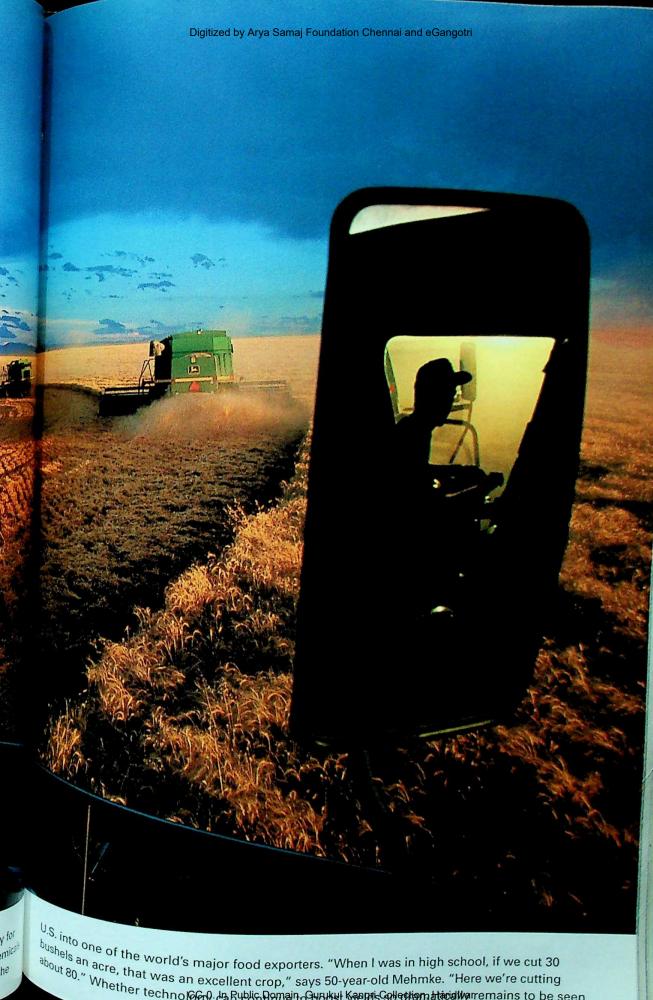
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A fleet of hired combines on Walter Mehmke's Montana farm cuts wheat destined mainly fol Pacific Rim nations. The use of such machinery along with high-yield plants and agrochemic has more than doubled அதி நக்கில் முற்ற முற்ற விழும் கூறு நடிக்கு நக்கில் முற்ற நக்கில் முறியில் முற்ற நக்கில் முற்ற நக்கில் முறியில் D.S. busi



bushels an acre, that was an excellent crop," says 50-year-old Mehmke. "Here we're cutting Whether to be so the public Domain Gyrkyl Kappis Collegion attackly remains to be so about 80." Whether technology da Rubin Hamein Obests! Kappis Gold Weller Here we re cutting
Whether technology da Rubin Hamein Obests! Kappis Gold Weller Hameins to be seen. reason for the disparity between haves and have-nots is politics. Most of the world's governments have the political will to assure their people the basic elements of a reliable food supply. But some don't.

N THE GLOBAL HIERARCHY of agricultural wealth, the ultimate haves are the broad, fertile, high-tech nations of North America, where a tiny portion of the population—about 3 percent in Canada, and even less in the United States—grows more food than their countrymen could ever eat.

Not long ago I traveled across the High Plains of eastern Colorado to visit a fairly typical American farm, owned by Bob and Joanna Sakata and their son R. T. Like many family farms, this one has a tale behind it: Bob grew up farming in California in the 1930s. In the wake of Pearl Harbor, for no reason except their race, Bob's family was shipped to an internment camp in the Utah desert. There Bob heard that Japanese-American farmers were still welcome in Colorado. In 1945 his whole family settled near Brighton and began to cultivate a 40-acre truck farm.

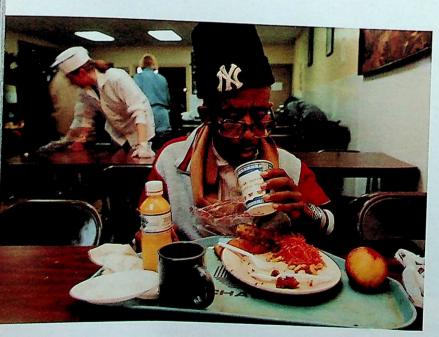
Five decades later the operation is known as Sakata Farms and covers some 3,500 acres along the South Platte River. Bob still calls his business a "small family farm," but its output is awesome: 20 million pounds of onions per year, 15 million pounds of cabbage, and 25 million pounds of corn. If you are reading this

in the U.S. in early autumn, the fresh company in the supermarket this morning may be Sakata Gourmet Extra Sweet.

"The only way you can stay in business a farmer," Bob told me, "is to boost yield a reduce your costs. Fifty years ago, when started here, an acre planted in onions wo produce about 200 sacks"—that is, 50-possacks of yellow onions. "When we got that to 350 sacks per acre, we thought we were hottest thing in farming. Today, if we do produce 800 sacks per acre, we can't compe with the guy down the road."

Increases like that come partly from research into new plant breeds, new fertilizers, and partly from massinvestment in high-tech equipment. Bob's see R. T., who got a college degree in biochemistre before returning to Brighton to grow vegetables, gave me a tour of the maintenance building. The place looked more like a Star Workhangar than a farmer's machinery shed.

The pride of Sakata Farms' big fleet is matched pair of Pixall Super Jack corn puller. These enormous yellow machines move slow but surely through a field of corn, grabbing each stalk and plucking off the ears so gent that barely a kernel is bruised in the process. The Super Jacks cost the Sakatas \$160,000 apiece in 1995, and maintenance costs astronomical: When one of the harvesters had a flat last summer, R. T. had to shell out \$900 for a new tube and tire. But these behemotic



Keeping body and soul together, 70-year-old Charles Smith visits New York's BOW ery Mission for a meal and a chapel service. Some 30 million people—mostly elderly. children, and the working poor—go hungry in the U.S. despite its wealth. "Many ask, 'Do I pay the rent or buy food?' Or in the winter, 'Dol heat or eat?" says Christing Vladimiroff, head of Second Harvest, a relief organization that distributes more than a billion pounds of food a year

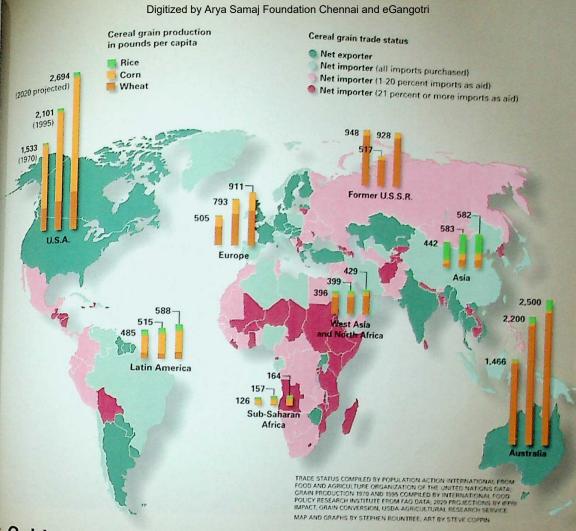
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Golden harvests from the good earth

"More than 99 percent of our food comes from the land," says David Pimentel, an agricultural scientist at Cornell University. "That's a fact that a lot of people don't appreciate." Among the many crops cultivated, grains provide at least 80 percent of food worldwide. Farmers and consumers alike benefit from grains' advantages. Yields per acre are normally abundant. Also, grains store and transport well—unlike potatoes, for they contain a nutritious mix of carbohydrates, proteins, and vitamins.

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Just three crops—wheat, rice, and corn—dominate grain production. This specialization has helped drive the agricultural boom of the and supplies targeted to one kind of plant Nelying so heavily on such a narrow genetic series.

could cause crop failure and famine.

Even if crops stay healthy and cereal grain production continues to climb as projected above, the global food supply may ultimately fall short. With growing populations of their own, regions that now enjoy a surplus will likely have less and less for export to those in need.

While the world's population has doubled in the past half century, its appetite for meat has quadrupled.

To produce more than 200 million tons of meat a year, livestock are now fed about 40 percent of all grain harvested.

Pounds of grain needed to produce one pound of bread or one pound of live weight gain in each animal.



pay their way. At the height of harvest season, each one picks and bundles 240,000 ears of sweet corn every day.

I was overwhelmed by the size, power, and complexity of those corn pullers. Tilting back the dark green Sun Seeds cap on his head, R. T. did his best to calm me down. "Yeah, these machines seem pretty impressive today," he said. "But in a few years, just to stay competitive, we'll probably have to find something that harvests even more. That's why, from our point of view, it's hard to think that the world's ever going to run out of food. Somebody's always finding ways to produce more and flooding the market. And the rest of us have to match it, and it just keeps going."

HE CORN the Sakatas produce in such abundance is a native American plant species, but it has also flourished, as a transplant, in most of central Africa. In fact, white-kerneled corn, known as maize, has become a staple food of sub-Saharan

Africa. People roast it right on the cob, grid it into meal, or serve it as a side dish similar to grits that is called *ugali* in Kenya and Tanzania, *posho* in Uganda, and *sadza* iz Zimbabwe. Even the churchyard of Hor Family Cathedral in central Nairobi has been used to plant a cornfield.

"The growing conditions here are unsurpassed anywhere," said Monty Crisp, an American development worker I met in Rwanda. It the central U.S. farm belt we have some rid soil but only one growing season per year. Here is great volcanic soil and the potential for two or three crops per year." Yet the IN Food and Agriculture Organization notes that sub-Saharan Africa is worse off nutritional today than it was 30 years ago, and hunger and malnutrition remain rampant.

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One reason is that the majority of African farmers cannot afford to buy improved servarieties, agrochemicals, or machinery. The tools: a machete to clear weeds and, some times, a single hoe for an entire farm farmer.



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Competing pressures

A new highway near Hong Kong has the right-of-way where a farmer now squeezes in a patch of bok choy. In the past decade development has overrun much of China's arable land. Meanwhile demand has risen for crops—to feed more people and to fatten more livestock for the tables of the newly affluent. In Guangzhou, a city of 6.5 million, the Tianhe slaughterhouse is expected to double its output of pork.



I saw this kind of agriculture in the hills of northern Kenya. A retired Wisconsin farmer named John Hooper—a volunteer for the Scottsdale, Arizona-based aid organization Food for the Hungry International—took me to visit a 4.5-acre farm, a large operation by local standards. As is common in Africa, the farmer was a woman: Ellen Kuraki, a strong, quiet mother of eight. Ellen's husband works as ^a pastor, so the farm is her responsibility.

Kuraki has vegetable plots, a mango grove, and a chicken house set high on a post to thwart marauding mongooses. But most of her farm is planted in maize. When the weather is reliable, she produces enough to feed the entire Kuraki family, with a little left over to sell. The farm generates about \$225 a year.

The biggest obstacle to earning more, Ellen told me, is time. She gets two crops of maize to Cht 41. Each harvest takes about two weeks to cut the stalks and pull the ears, and then another week or so to clear the field for the next planting. It is all hand labor. Hearing that,

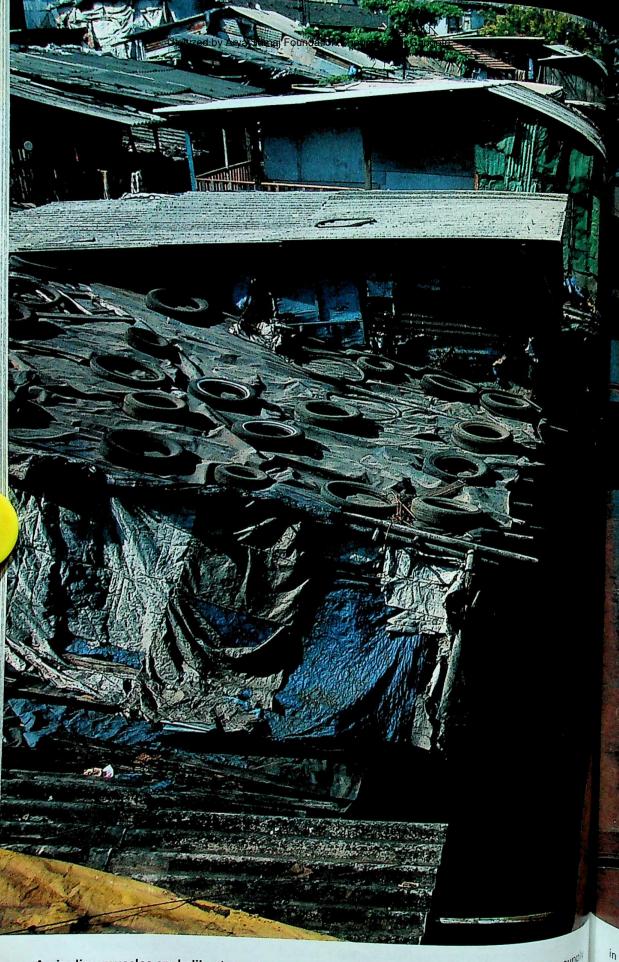
I began thinking about what she might do with a miniature version of the Sakatas' huge cornpuller. The same thought occurred to John Hooper. "You know, with one of those small combines they sell now," he said, "she could clear this whole field, shell every ear, and it would take, oh, half an hour or so."

When Ellen overheard us talking about farm machines, her eyes grew wide. "If I had a tractor," she said, "we could grow so much!" And then her smile faded. "But we have no money, we have no fuel, we have no parts to keep a tractor running. It's just not possible."

In other parts of the world governments help provide the seeds, tools, and soil conservation farmers require. But they begin by supplying political stability. Amid the nearly endless civil strife that has beset equatorial Africa, farmers' needs have gone largely unmet.

"We have always been farmers, but how can we farm now?" said an intense, angry man named Bulondo Musemakweli, whom I visited in the village of Nzulu, on the bank of ink-blue

FEEDING THE PLANET



A pipeline muscles snakelike through a suburb of Mumbai, formerly Bombay, in India to support richer areas with plenty of water. Buying into a neighborhood with such amenities is beyond the means of residents does not be the m

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in alleyways. Even with international efforts to make access easier, more than a billion people around the world still don't have a reliable source of water that is safe to drink. With the global swelling by ab661080 Phillion a year, the strange of water that is safe to drink. With the global swelling by ab661080 Phillion a year, the strange of water that is safe to drink.

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Lake Kivu. Bulondo, a short, muscular father of 12, is the headman of Nzulu, near the eastern border of the Democratic Republic of the Congo. The village is home to 500 people who have been swept into a state of hunger and poverty by distant political manipulations.

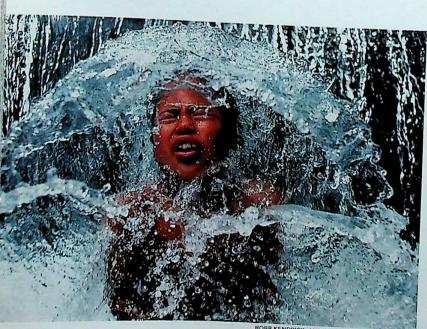
In 1994, Bulondo told me, hordes of refugees fleeing civil war in neighboring Rwanda flocked to the shores of Lake Kivu. Frightened and famished, they swept down on Nzulu's maize and vegetable fields by the tens of thousands, eating everything and leaving Bulondo and his people with no food and no seed for the next planting. It took two years of hunger and hard work before the village had another crop, and that crop was stolen by soldiers fighting the Zairean civil war in 1996. This year wandering troops from both sides of that war have been raiding fields at gunpoint. "We have people here, good farmers, who no longer plant," Bulondo said. "Even if they do the work, they figure some army will come by and steal their harvest."

Towns and villages all over central Africa have suffered from political turmoil. In response, international agencies and volunteer groups have flocked to the region to feed the afflicted. I met many of these volunteers in Africa—people who left lives of comfort in Japan or Germany, London or Louisville to live in faraway villages and help others—and was inspired by their example. And yet, I found many of them to be conflicted.

"Sure, it's good that we're here helping he gry people get food," said Merry Fitzpatrid, former Air Force officer from North Carolin who worked with Food for the Hungry in the Democratic Republic of the Congo. "But relie work is a Band-Aid. And the wound here goe too deep for a Band-Aid. The real problem people hating people and the political game that result from hate. If the politics were even settled, Africa would feed itself just fine."

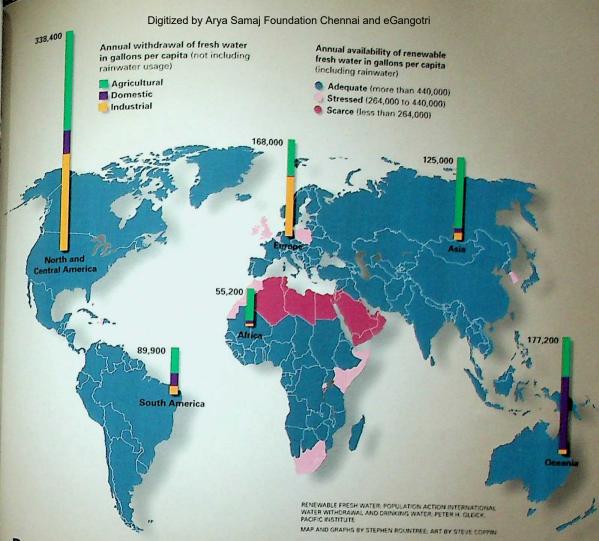
HE RELATIONSHIP between politics are food supply is reflected in the late 20th-century downs and ups of Chiral which has more mouths to feed the any nation on Earth. During Mao Zedong Great Leap Forward of the late 1950s, Chiral was ravaged by famines that killed tens of millions and reduced average calorie intake for below the recommended level. Today, with a market-oriented economy that has produced the world's highest growth rates, some Chinese have a different food problem.

"It's amazing to say, but our problem's becoming overnutrition," says Ho Zhiqian, friendly, talkative nutrition expert on the government's National Food Advisory Commission. "Today in China obesity is becoming common. We have more diabetes than the United States. Breast cancer is multiplying I believe these are related to consumption danimal fat—you know, eggs, meat, butter—is a normal part of the daily diet."



Indonesia, as it cascades in an aqueduct that irrigates rice fields. Close to its source, a volcanic lake, this water runs clean. As it flows from one field to the next, though, it accumulates fertilizers and pesticides. In agriculture as well as in domestic and industrial settings water moves from use to use, and with each cycle it becomes more contaminated. Purifying it after such hard use is difficult and expensive.

Water refreshes a boy in Ball



Preserving the essence of life

Once considered an unlimited resource free for the taking, clean water is becoming a scarce and valuable commodity. Though most countries still have adequate supplies,

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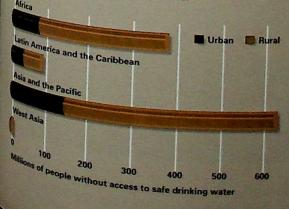
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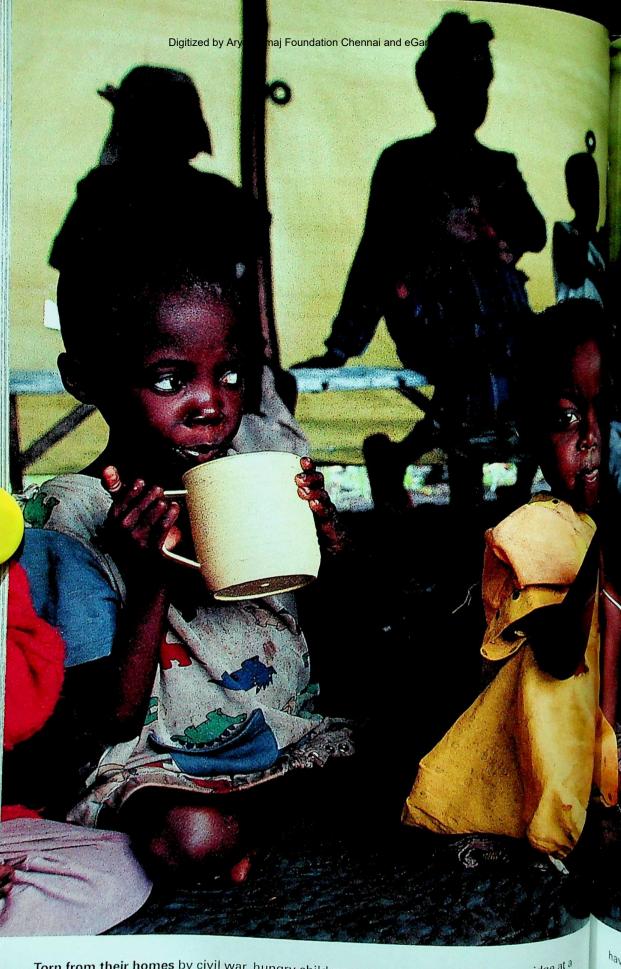
The developing world's drinking glass is only part full. Lack of infrastructure keeps a quarter of that population from getting safe water. As a result, five to ten million people die each year from water-related diseases such as cholera.



as illustrated above, continued depletion of wells and springs, wasteful use, and pollution will reduce what is available in the future.

As economies in Asia, Africa, and Latin America develop, competition for water between industry and agriculture will likely intensify, driving up its cost. With more than a third of the world's harvest grown on irrigated land, price wars over water can make food more expensive. In addition, modern agriculture requires more water than any other activity, accounting for 70 to 80 percent of all use. If farmers are forced to cut back, they will have to find new agrarian strategies.

In the past, dams, reservoirs, and aqueducts delivered water to meet increased demand. Today, however, economic and environmental costs generate opposition to new construction in many places. To have enough water in the long run, we now must pay more attention to using it efficiently and keeping it cleaner as we do so.



Torn from their homes by civil war, hungry children get protein and fluid from porridge at a refugee camp in the Democratic Republic of the Congo. "This area, North Kivu, is the country breadbasket," says Moolo செய்ய மெய்ய இருந்து இருந்து முற்ற குறிய மெய்ய மாகம் மாய்யில் மாகம் மாக



have people in these therapeutic feeding centers solely because of the fighting." Children here eat every three hours. Around the world millions of chronically undernourished children are mentally and physically and left especially vulnerable to disease. Each day 19,000 die.

Life's eternal circle is certain: Just as there is death—marked in India by pyres on the Ganges so there is birth, bringing more hungry mouths into the world. "It is possible to feed them all the resource of th so there is birth, bringing more number of the wisdom and the resources. I work says Second Harvest's Christine Vladimiroff. "We have the wisdom and the resources. I work says Second Harvest's Christine Vladimiroff." if we can find the compassion and the international political will to accomplish it."

Today's increasingly prosperous China can afford meat. The Chinese already eat about as much pork per capita as Americans do; chicken and beef consumption is also climbing fast. This changing diet has forced big changes in Chinese agriculture. To meet the needs of 1.2 billion consumers, the nation is moving away from the traditional communal plots to Western-style agribusiness. I saw that change for myself at China's largest chicken farm, the Shanghai Dajiang company's operation in Songjiang, a town about an hour's drive south of Shanghai.

The place is not so much a farm as a factory, with massive conveyor belts carrying fuzzy day-old chicks by the tens of thousands. Its feeding sheds hold 20,000 birds apiece. The chickens are fattened on carefully formulated feed; after 49 days of steady eating, they themselves become food.

Dajiang sells a million chickens a week. Most go to China's new supermarkets, but a growing percentage are shipped to the company's retail arm, Fast Food Dajiang, which competes directly with the country's most popular restaurant franchise, Kentucky Fried Chicken.

"When we opened the factory we were really aiming at export sales to Japan," Liu Jian, a Dajiang executive, told me as he munched on a soy-marinated drumstick at one of Fast Food Dajiang's outlets. "But now the Chinese demand is so strong that our market is overwhelmingly domestic."

For a Western hamburger lover like me, it seems almost churlish to complain if Chinese people, too, want meat on the table. But in global terms there is real concern about this shift. A meat-centered diet is an inefficient use of resources because you have to feed the animal before it's fed to people. To reach slaughter weight at 240 pounds, for example, a U.S. pig consumes some 600 pounds of corn and 100 pounds of soybean meal. The retail meat yield from that animal would provide a person with the UN's recommended 2,200 minimum daily calories for about 49 days. Eating the corn and soybean meal directly, the same person would have enough food for more than 500 days.

AN CHINA PRODUCE ENOUGH gr to feed enough livestock to salisf billion meat-eaters? Many economic and agricultural experts fear 10 If China becomes a dramatically larger to buyer—and it's already among the work greatest grain importers—that may raise prize for every other hungry country.

The Chinese insist that the world's ma populous country can feed itself. They not proudly that they have more than triple domestic grain production over the past le century. Wherever I went in China, office showed me plans to expand the supply of are ble fields—by terracing hillsides, converting parks and cemeteries, even creating new land They convinced me that China has found in political will to make sure its people are feld commitment that is commonplace in Wester democracies but one I did not find in Afric

I was reminded of that difference during a luncheon with Ho Zhiqian, the friend nutrition expert. Ho is a professor at Sun 1/2" sen Medical University in Guangzhou, 21 he looked the part: gold wire-rimmed glassa V-neck sweater, striped tie, and a button down collar he had left unbuttoned. Guangzhou booster, Ho suggested we dine some of the city's famous culinary specialties

Lunch was fabulous. We had fresh shrim braised sea bass, chicken with bean sprouts spicy pork ribs, and succulent fried rice. By the final course we were so stuffed that my que tion seemed utterly superfluous, but I turned to my host and asked him anyway. Can the Earth continue to feed its growing population

"Oh, Mr. Reid, you've asked the wrong person," the professor replied in his amail way. "I've devoted my life to the study of food supplies, diet, and nutrition. But por question goes way beyond those fields. Can Earth feed all its people? That, I'm afraid, strictly a political question."

T. R. Reid writes about fresh water and how pres produced by population growth affect the resolution available for drinking, sanitation, industry, and culture at www.nationalgeographic.com/features/population/planet population/planet.

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Lewis and Clark

NATURALIST-EXPLORERS

BY RON FISHER

E very day brought something new. A stately proughore

perhaps, watchful under darkening skies Or is

vine maple—its leaf sketched onto a for mali

Meriwether Lewis and William Clark

the Louisiana territory to

queets" one day. "I

To Lawring !

Porcupin rabi

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N THE UNITED STATES in 1800 there were no grizzly bears. Or prairie dogs or cutthroat trout. No white-tailed jackrabbits or pronghorn. Or ponderosa pines. No

sage grouse. Prairie falcons hunted elsewhere.
These particular bears and birds and trees
and fishes—and scores more equally familiar—were all in a foreign place called Louisiana.

But by 1803 that had changed.

Soon after President Thomas Jefferson acquired the Louisiana Purchase in April 1803, Meriwether Lewis and William Clark and their Corps of Discovery set out to see what was there, and like magicians pulling rabbits from a hat, the two men made wonderful things appear.

The highlights of the expedition are familiar: the assembling of a group of "robust... helthy hardy young men"; the struggle up the roiling Missouri River; the lone death, unlucky Sergeant Floyd; winter among the Mandan Indians in North Dakota; Sacagawea and her baby; the crossing of the Eden-like Great Plains and the portage around the Great Falls of the Missouri; the Bitterroots; the descent of the Salmon and Columbia Rivers to the Pacific; the depressing winter at Fort Clatsop; and the return home.

The success of the expedition made Lewis and Clark famous as explorers, woodsmen, and military leaders, but their skills as scientists went unrecognized. At the end of the expedition Lewis announced that their journals would be published, including a volume

RON FISHER first wrote about Lewis and Clark in 1970 and has been an enthusiast ever since. Over the years he has visited many of the expedition's sites—from St. Louis to the snows of North Dakota and the cold drizzle of the Oregon coast.

"confined exclusively to scientific research, an principally to the natural history of the hitherto unknown regions." But he died before the volume was completed, and it never appeared. The world was left with the image of Lewis and Clark as courageous adventure.

It would be a century before it became generally known that during their epic journed Lewis and Clark recorded hundreds of plant and animals that, though intimately familiar the nations of Indians living in the American West, were new to science.

And it's only now, with the publication as a multivolume work by the University of Nebraska, that a comprehensive picture of the contribution of Lewis and Clark is emerging-nearly 200 years after the expedition. Game E. Moulton, professor of history at Nebraska and editor of the journals, says, "Lewis and Clark provided us with a record of the biotact the trans-Mississippi West that is as close as we can get to seeing it in its natural conditionabefore all the plowing and planting by Euro Americans. They brought back a remarkable record of it."

Jefferson's instructions to the explorers were detailed, having to do mostly with finding Northwest Passage, but he was interested in every aspect of the land. Observe, he instructed them, "the face of the country, it's growth is vegetable productions... the animals of the country generally, & especially those how known in the U.S." Observe, he wrote, the dates at which particular plants put forther lose their flowers, or leaf, times of appearance of particular birds, reptiles or insects."

Of the two men who pushed off up the muddy Missouri River on May 21, 1804, the head of their party, Lewis was the better naturalist but Clark the more accomplished geographer and (Continued on page 8)

Adrift in a sea of prose, a coho salmon sprawls across a page of Lewis's journal. Indians gigged the two-foot-eight-inch, ten-pound fish near the expedition's winter quarters on the Pacific coast. "This is a likness of it," Lewis wrote.

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the rocks. the shele is then and consists of one values. a small circular apperture is formed in the center of the under shell . The animal is soft & boneles . -The white salmon Trout which we had previously som seen only at the great falls of the bolumbia has now made it's appearance in the creeks near this place. one of them was brought us to. · day by an andian who had just taken it with his gig. This is a likenep of it; it was 2 feet 8 Inches long, and weighed 10ths. The eye is mo, derately large, the perfete with a small somition of yellow, and iris of a silvery white, black is a little. terbid near it's border with a yellowish brown. The position of the fine may be seen from the drawing, They are small. in proportion to the fish . the fins are boney but not pointes except the tail and back fins which are a lettle so, the prime back fin and vental ones, contain each ten rays; those of the gills . therteen, that of the lail truelve, and the small fin placed near the · tail above has no bony rays, but is a tough flexable substance covered night amouth skin it is thicker in proportion to its with than the salmon. the tange is thick and firm beset on each border emale subulate beth in a single series. The kets of the mouth are as before sis a -cribes. neither this fish nor the salman are caught with the hook, nor do Ihnow on what they feed. MERIWETHER LEWIS

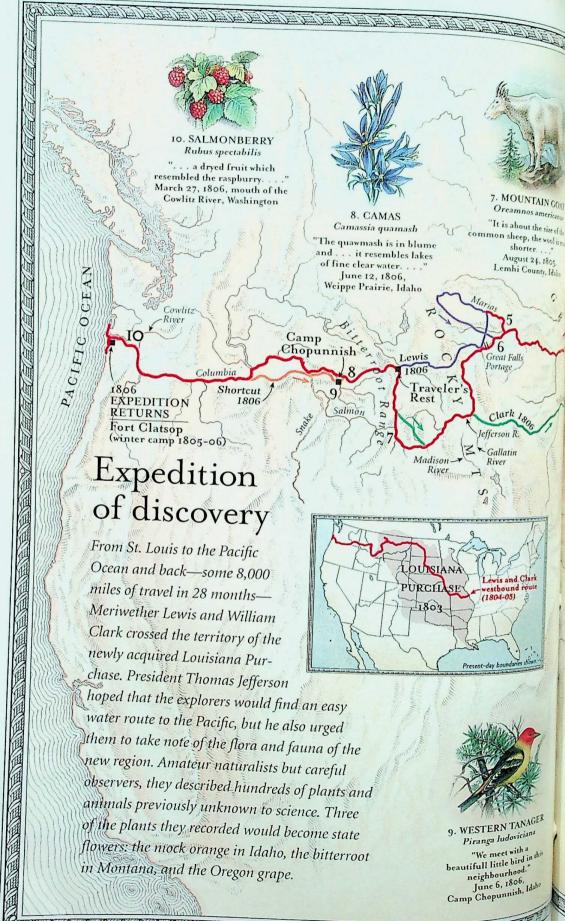
LEWIS AND CLARK, NATURE OF STPUNION DOMBINS Gurukul Kangri Collection, Haridwar

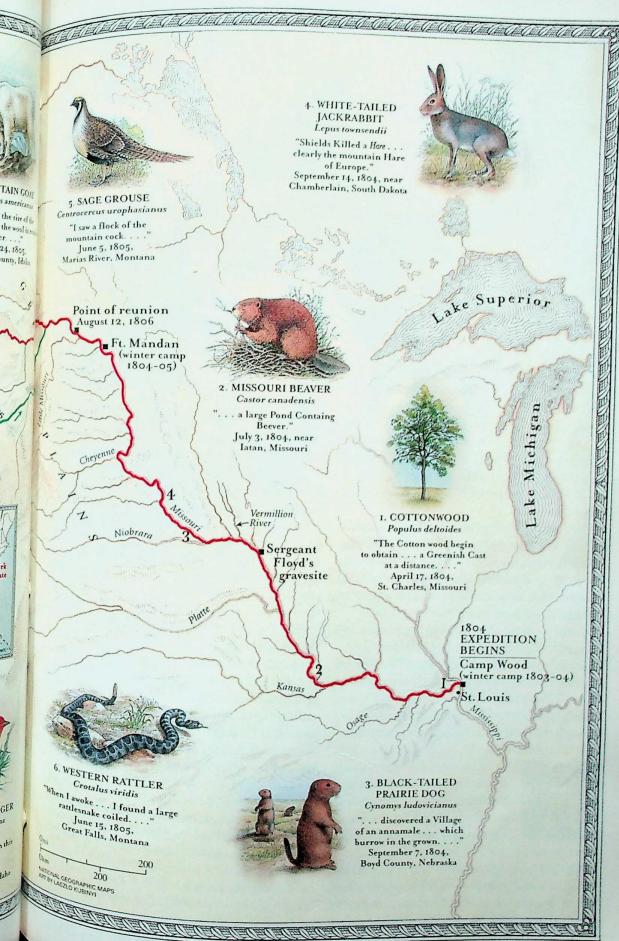
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"It's colour is yellowish brown, the eyes small, black, and piercing. . . . these bear being so hard to die reather intimedates us all; I must confess that I do not like the gentlemen and had reather fight two Indians than one bear."

- MERIWETHER LEWIS

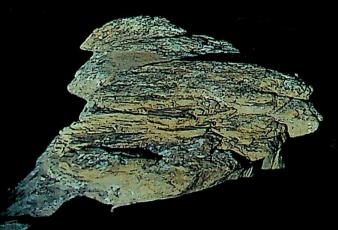
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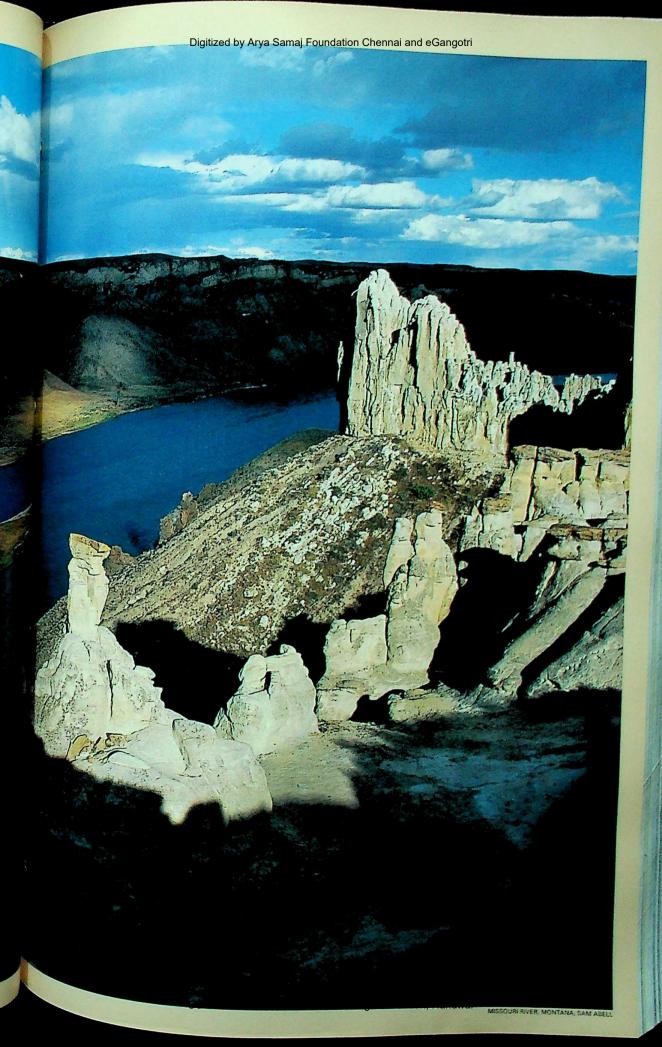




"The hills and river Clifts which we passed today exhibit a most romantic appearance. . . . With the help of a little immagination . . . [they] are made to represent eligant ranges of lofty freestone buildings. . . . it seemed as if those seens of visionary inchantment would never have and end."

- MERIWETHER LEWIS







MERIWETHER LEWIS (OPPOSITE); CHARLES SLEICHER, TONY STONE IMAGES

Flurries dust a captive western mountain lion in Montana. The explorers, familiar with the big cats of the Appalachians, called the animals panthers. "It is precisily the Same animal common to the Atlantic States," wrote Clark. The panthers were difficult to hunt, he added, being "So remarkable Shye and watchfull." Lewis and Clark devoted thousands of words in their journals to precise and colorful natural history observations, a scientific contribution long overshadowed by their adventures.

exists as it dose without water... we have sometimes found that villages at the distance of five or a miles from any water."

I take a seat one blustery October day at the edge of a prairie does town in Montana, just back from the Yellowstone River. Clark and a party of the men descended the river during the expedition's return from the coast. A cold wind send an overcast sky scudding. Score of prairie dogs are out and about looking fat and sleek as they prepare for winter.

I find that if I sit quietly, they feed practically at my feet. They re the color of the brown grass they're eating. They move along on all four picking up tidbits with one parnibbling. One suddenly stands on its hind legs and emits a squeak. They have dark brown eyes and tiny ears folded into their fur. A large one as fat as a footbal comes running up to another in a rocking-horse motion, and the touch noses, which looks like they stand peer they stand peer to the practical process.

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ing around with a slight frown, their hand held in front of them, like Queen Elizabeth. One barks furiously when I depart. With early yelp its head bobs and its tail wags, which makes it look like a mechanical toy.

One prairie dog from the Lewis and Classexpedition made a remarkable journey. From their first winter quarters at Fort Mandan North Dakota the corps sent it, along with shipment of scientific specimens, back to ferson. After a journey of four months 4,000 miles—down the Missouri and Missispi Rivers to New Orleans, then by occar going sailing ship to Baltimore—the prairie dog reached Washington safely. It lived a while in the President's House, then the Peale Museum in Philadelphia. It survive



CALIFORNIA CONDOR, GYMNOGYPS CALIFORNIANUS

there for at least six months before passing quietly into history.

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Sometimes Lewis noticed things other observers might have missed. He wrote hundreds of words of meticulous description of the mule deer, new to science, noting its size, summer and winter coats, antlers, habitat, mulelike ears and tail, and behavior. Then he described, on the inner corner of each eye, "a drane or large recepticle." This, the melancholy Meriwether Lewis thought, gave the mule deer "the appearance of weeping."

There came a day when up from the underbrush loomed a creature whose reputation had preceded it—the grizzly bear. The corps first encountered the grizzly near present-day Bismarck, North Dakota. The Indians had warned them of its strength and ferocity. On April 29, 1805, they shot and killed one in Montana. "The Indians may well fear this anamal, equiped as they generally are with their bows and arrows . . . but in the hands of skillfull riflemen they are by no means as formidable or dangerous as they have been represented."

In a few weeks, however, after his men had had a number of narrow escapes, Lewis would be referring to them as "those tremendious anamals." Several of the men, even Lewis himself, were chased up trees or into their canoes by wounded grizzlies. Lewis wrote: "I find that the curiossity of our party is pretty well satisfied with rispect to this anamal."

Of the birds in the sky, Lewis noted "the peculiar whistleing" of one new to him and coined its popular name: the whistling swan. And they killed "a Buzzard of the large Kind" —a California condor, which measured nine and a half feet from wing tip to wing tip. In tana, Lewis "saw a black woodpecker. . . . a disonly bird named for Lewis—Melanerpes lewis, No.

Not much later, in Idaho, Clark saw a bine burs. Nucifraga columbiana, or Clark's

nutcracker, the only bird named for him.

Avid and intense, Lewis used all five senses when examining new animals or plants. In his journals he reproduced phonetically the calls of new birds. And of sagebrush he wrote: "On these hills many aromatic herbs are seen; resembling in taste, smel and appearance, the sage, hysop, wormwood, southernwood, and two other herbs which are strangers to me; the one resembling the camphor in taste and smell, rising to the hight of 2 or 3 feet; the other about the same size, has a long, narrow, smooth, soft leaf of an agreeable smel and flavor; of this last the Atelope is very fond; they feed on it, and perfume the hair of their foreheads and necks with it by rubing against it."

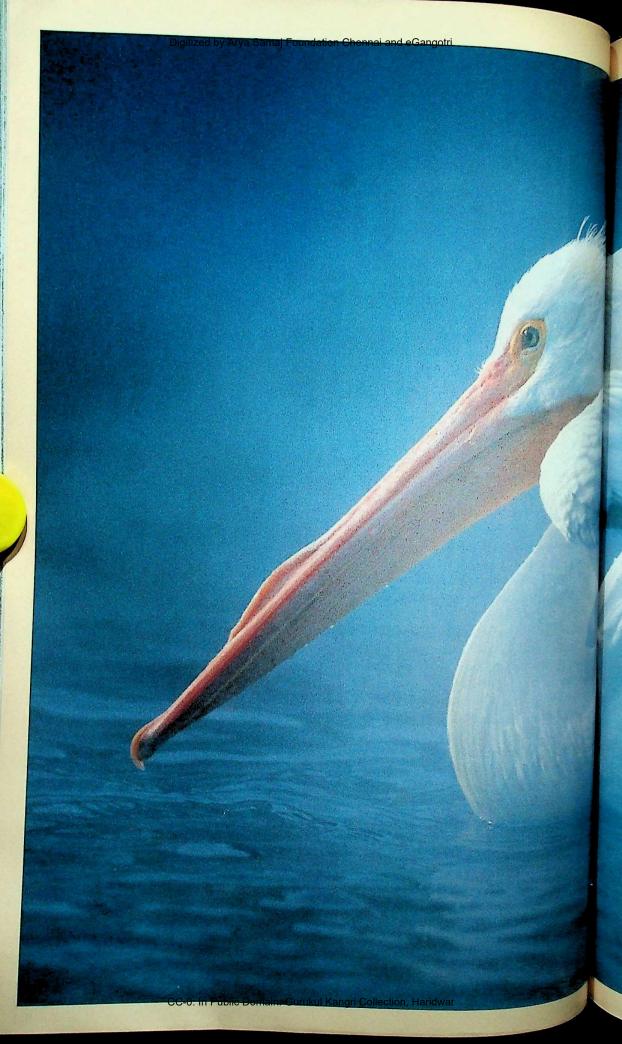
the western plains, through mountains and river valleys, Lewis and Clark kept their collecting bags at hand. In addi-

tion to noting animals new to science, they collected dozens of plant specimens, drying and pressing them for the trip back east.

In Montana, Stu Knapp and I stop at Missouri Headwaters State Park, where the Jefferson, Gallatin, and Madison Rivers come together to form the Missouri. As we stroll through the sunny park, with crows cawing in the trees, Stu stops often to point out and gently touch what he calls "Lewis and Clark plants"—those species the captains brought back or described. Rabbitbrush, cudweed sagewort, blue bunch wheatgrass.

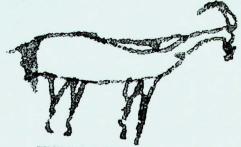
"This little bush is Rocky Mountain juniper," says Stu. "This is Woods' rose—Rosa woodsii, the western wild rose." Buffaloberry, greasewood, nipple cactus—Stu knows them all. "About 30 species of Lewis and Clark plants have been found just in this little park."

The plants they collected between their winter quarters in North Dakota and the Great Falls of the Missouri were stored in a cache to be picked up on the homeward journey. But tragically, when they returned the following



"I saw a great number of feathers floating down the river. . . . they appeared in such quantities as to cover pretty generally sixty or seventy yards of the breadth of the river. . . . we did not percieve from whence they came, at length we were surprised by the appearance of a flock of Pillican at rest on a large sand bar attached to a small Island the number of which would if estimated appear almost in credible."

- MERIWETHER LEWIS



BIGHORN SHEEP OVIS CANADENSIS

year, they found that water had seeped into the cache, destroying most of the specimens. This heartbreaking loss meant not only a failure of part of their mission—to record new flora—but also the ruin of months of hard work.

Still, Lewis returned with about 200 plant specimens gathered between Great Falls and the coast. Today most are at the Academy of Natural Sciences in Philadelphia.

Alfred "Ernie" Schuyler, associate curator of botany at the museum, spreads some on a table for me. They're kept in thin brown folders, like documents, their leaves and stems a brittle brown now, but they still carry an aura from the day they were snipped off a living plant.

"Lewis evidently just pressed specimens between loose sheets or in a book of some sort," says Ernie. "There'd have been one bundle in the process of being dried, which he'd have put beside the fire at night. Periodically he'd have removed specimens from that collection and added them to a finished bundle."

Dried specimens appear on the table before me: ragged robin, bitterroot, buffaloberry, Osage orange, Indian tobacco, bear grass, yellow bell, its dried bell nearly colorless now but still drooping gracefully.

"The botany of Lewis and Clark really has been a neglected area," says Ernie. "They discovered a lot of the plants you see today in wildflower guides. Drive through the northern Rockies and you have a pretty good chance of seeing 10 or 20 species that Lewis discovered. Very thorough."

Of the trees Lewis and Clark recorded, none was more important to them than the broad-leaved cottonwood. The corps used cottonwood to make dugout canoes and a mast for their keelboat; during the portage around Great Falls they built wagons whose wheels were cross sections cut from cottonwoods; and time and again they camped under the

welcoming shelter of the giant trees. When they came upon a grove, Lewis wrote that trees "were quite reviving after the drairy out try through which we had been passing."

One plant saved their lives while nearly ing them. During the grueling crossing of the Rockies food ran low, and the men almostarved. When they reached the prairies to west of the mountains, Nez Perce Indians grethem food, including dried salmon and the steamed roots of the camas, a member of the lily family. Cooked, the roots had "a sweet tast and much the consistency of a roast onion," Lewis thought. Over the next few do the hungry men gorged themselves on this nearly all became seriously ill with stomach cramps and diarrhea. Lewis bland the camas, which "is pallateable but disagree with me in every shape I have ever used it."

O

Pacific, Lewis and Clark rainto fewer new mammals and more birds and fish—including steelhead and the Columns

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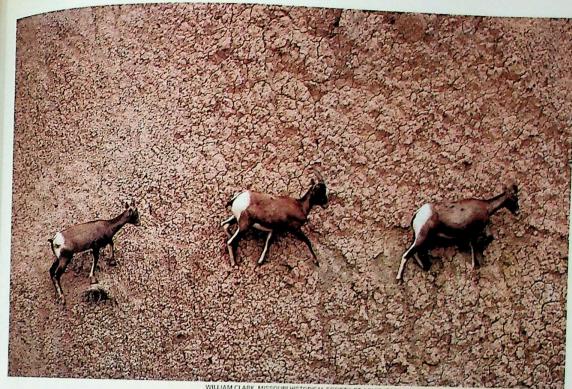
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bian sharp-tailed grouse. Lewis, the carell observer, checked the grouse's feathers and ticed that "in the winter season this bird booted even to the first joint of it's toes."

During the cold and rainy winter they spend in Fort Clatsop on the Oregon coast, Lewin made careful descriptions of some three dozen plants and a hundred animals, including mammals, 50 birds, 10 reptiles and fish, and 5 invertebrates. He wrote thousands words. He used, by one count, some 200 technical botanical terms—words like fusiform peduncle, petiolate, carinated, and perical terms—words like fusiform peduncle, petiolated peduncle, pedunc

We shouldn't be surprised. Both Len and Clark—and Jefferson too—were men their time, the age of Enlightenment. Amateural world, and not just out of curiosity.



WILLIAM CLARK, MISSOURI HISTORICAL SOCIETY, ST. LOUIS (OPPOSITE), STEPHEN SHARNOFF, NGS IMAGE COLLECTION

"With apparent unconcern," as Lewis wrote, bighorn sheep cross a cliff face in South Dakota. The explorers often saw the creatures—"a kind of Anamale with large Circuler horns"—in places where "had they made one false step the[y] must have been precipitated" at least 500 feet.

knowledge, they reasoned, should be put to practical use for the betterment of mankind. So Lewis and Clark continually quizzed the Indians about the uses to which they put various plants; they looked for mineral deposits; they mapped the heaviest concentrations of beaver for future trappers; they noted lands suitable for farming.

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In the spring of 1806 the corps started for home. And on September 20 they spotted animals that thrilled them as much as any they had seen—domestic cows. It meant they were nearly home and "Caused a Shout to be raised for joy."

Well before they sent the prairie dog to lefferson from Fort Mandan, they had sent cuttings from several plants, including Osage orange trees. Today there are trees at the Unito be growing from those nearly 200-year-old sity's landscape superintendent, one chilly day house where visiting professors stay. "I love this

old tree," says Jeff, touching its rough bark. "It has character."

It's gnarled and ancient, its trunk twisted around upon itself, blackened scars showing where limbs have been removed. A cardinal chirps in its uppermost branches, and ivy grows up its flank. Osage oranges the size of grapefruit lie scattered on the ground, many chewed by squirrels. "They sit on the ground and gnaw at the balls until they have them down to a size they can carry aloft," says Jeff. "They sit up there and eat them." On overhead branches little piles of nibblings show where they have perched.

The tree is scarred and bent but tough. It survives today alongside other less tangible legacies of the Corps of Discovery—competence and strength, discipline, enlightened curiosity, and the priceless capacity, when confronted with new wonders from the natural world, to be dazzled.

Journey online with Lewis and Clark at www.nationalgeographic.com/features/98/lewisclark.

Digitized by Arya Samaj Foundation Chennai and eGangotri

THE FSSENC

By CATHY NEWMAN NATIONAL GEOGRAPHIC SENIOR S

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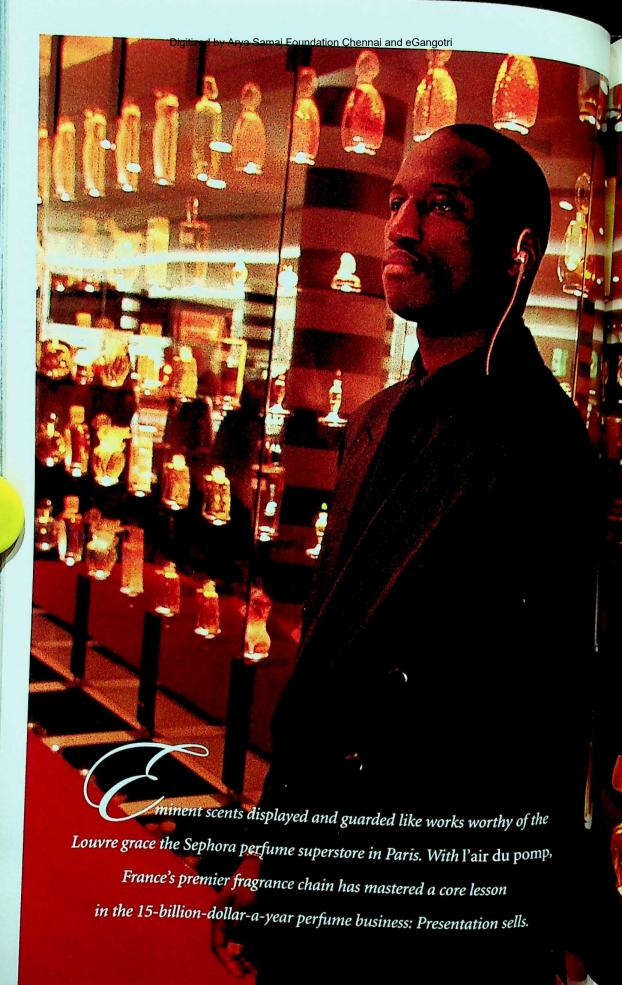
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Dew-kissed petals of damask roses spill from practiced fingers in Bulgaria's Valley of Roses. The traditional harvest—spanning some 350 years—yields oil prized in many fine fragrances. On the arduous road from petals to perfume, a global industry rides.

OF ILLUSION

Photographs by ROBB KENDRICK

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"Do you think of yourself as sensual or elegant?" Cathleen Montrose asks, pen poised over a yellow legal pad.

I'm in an office high above Madison Avenue in New York City. Common for Price of the City. Commo leen, vice president of creative development for Firmenich, a companies, a companies of the Calvin Main and Back and Bac that creates scents for houses like Calvin Klein and Estée Lauder, is about to shepherd me through the process of fragrance creation.

"Elegant," I say, glancing down at a run in my stocking.

"What colors do you wear?"

"Black," I reply.

"And?"

"Off-black."

"And?"

"Navy."

A hard look.

Suddenly, I'm babbling. "I'd rather sit with a book than attenda party. If I could afford them, I'd buy emeralds, not diamonds. I prefer



ocean to mountains and can't stand suffocating florals." "NO TUBEROSE," Montrose scribbles.

"Given my choice, I'd wear Yves St. Laurent, not that fussy Christian Lacroix (noting chewed fingernails); I prefer red wine to white (inspecting ink stain on hand), and I love John Singer Sargent portrails 0

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I take a deep breath. "I'd like an understated perfume. Sparkling Sophisticated. Witty."

ROBB KENDRICK has been contributing photographs to the magazine since less. He lives on the Bad Dog Ranch in the Translation of the magazine since less than the same and the He lives on the Bad Dog Ranch in the Texas Hill Country.

The confession will be distilled into what's known as a brief—an outline of the perfume's concept and target customer (Generation X, ladies who lunch, or, in this case, me). The brief ("A fragrance that does not shout. Elegant, crisp, sophisticated," it reads) will be handed to five perfumers, each of whom will create a "Cathy" perfume. I will be expected to choose my favorite. If I were a big company like Christian Dior Perfumes, the process would be much the same, except that other suppliers such as Givaudan Roure, International Flavors & Fragrances (IFF), and Quest International would compete to create my perfume.

I'm invited to return in two weeks for the first round of submissions. I leave, and on the way to my next interview a lightbulb clicks on.

I've created a fantasy of myself.

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Emeralds, red wine, Yves St. Laurent. Right. I grew up on Miami Beach, Florida, where a fashion statement was a clear plastic handbag trimmed with seashells and the nearest thing to wine on the table was seltzer water. I've been seduced by a never-to-be image. I've heard the siren song of glamour.

"Perfume," says Sophia Grojsman, IFF's star perfumer, "is a promise in a bottle."

We want to believe. We crave to be prettier, richer, sexier, happier than we are. "Aspirational" the industry calls it. Perfume speaks more to our vulnerabilities than our strengths. Consider the labels on the fragrances we buy: Joy, Dolce Vita, Pleasures, White Diamonds, Beautiful.

Said Charles Revson, the cosmetics czar who in 1973 created Charlie, the first American-lifestyle perfume: "We sell hope."

And we buy. Last year worldwide sales of fragrance topped 15 billion dollars, more than 6 billion dollars in the United States alone.

The silver-tongued industry that conjures these dreams is part circus, part creative magic, with smoke and mirrors galore. (Indeed the word perfume probably comes from the Provençal word perfumar: to spread smoke. The first perfumes were incense, an unfurling plume of hope directed at the gods.)

"It's an industry of myths," says Allan Mottus, a publisher and consultant. "It does not hold up under the scrutiny of daylight."

We sit in a coffee shop off Union Square in New York, as Mottus recounts stories of hit perfumes: "Giorgio was done on a wing and a prayer, a toll-free number, a magazine scent strip, and went off the charts." Flops: "If you've got a dog, you can't dress it up and take it to a dance." Arrogance: "Someone has a hit, then everyone else says, I can do that—it's a lot like show business," Mottus sighs.

Despite the hype, the allure of fragrance is real. The seductive power of perfume is as old as Cleopatra, who, not wanting to underplay her hand, received the Roman statesman Mark Antony on a barge with Sails soaked in fragrance "so perfumed," Shakespeare tells us, "that the winds were lovesick with them."

Assyrians perfumed their beards. Nero bathed in rose wine. In the 18th century scented woodwork decorated many a boudoir.
"While my below

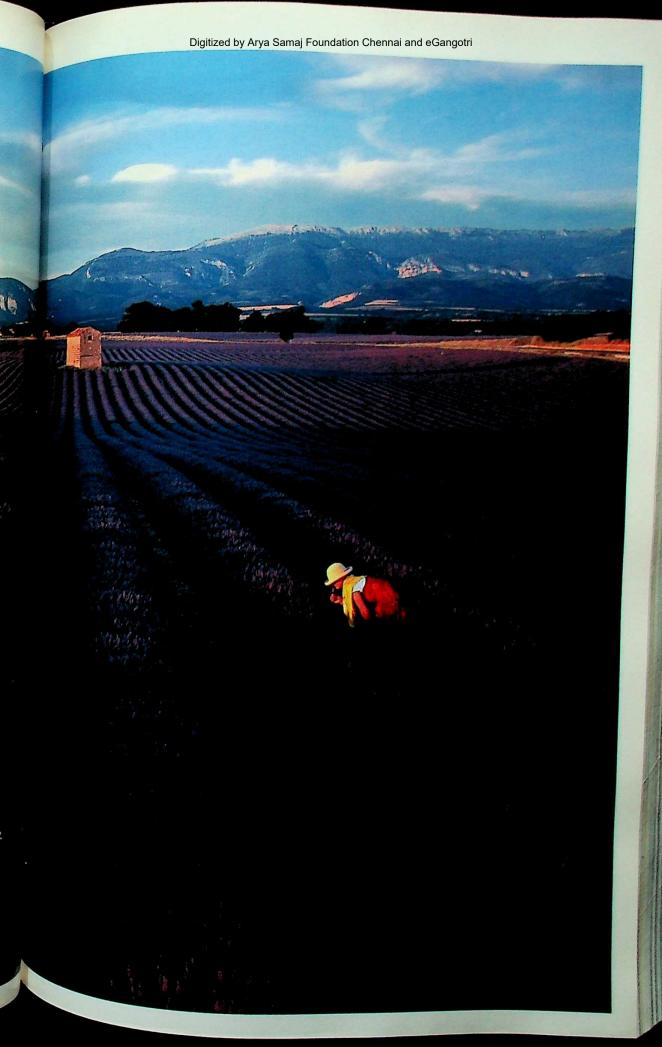
While other spirits sail on symphonies / Mine, my beloved, swims along your scent," wrote the 19th-century poet Baudelaire.

For Baudelaire—and many of us—fragrance taps into deep wells of memory and desire. Sometimes, with vengeance. Consider the jilted girlfriend who, before her furious departure, poured an entire bottle of her perfume on her ex's sheets.

or me perfume is an indulgence," says Angie Battaglia (opposite). The Austin, Texas, businesswoman owns nearly 30 scents, which she'll select depending on the season, her mood, or her dress. "Perfumes are an accessory,

like jewelry. Some are conservative, others lively, like uncorking champagne." Manufacturers, who now offer about a thousand fragrances, scramble to attract today's fickle consumers.

PERFUME, THE ESSENCE OF 10 In Bull in Domain. Gurukul Kangri Collection, Haridwar



Memory and fragrance are intertwined, some biologists insist, because the sense of smell plugs smack into the limbic system, the seat of emotion in the brain. No other sense has such immediate access.

My mother wore L'Heure Bleue. To unstopper that dusky scent returns me to my child self, tucked into bed. Late at night, after being out, she would come into my room to kiss me, enveloping me in a cloud of powdery warmth.

For Thierry Wasser, a perfumer at Firmenich, the scent of Chanel's Cuir de Russie conjures his father.

"My father always wore driving gloves," Wasser says, toying with a bottle of fragrance in front of him. "He would splash on his fragrance, pull on his gloves, and drive off. He left for good when I was three. He died when I was 15. He pulled off the road in the south of France and slumped over the wheel. A heart attack.

"At 18 I learned to drive. I took out his gloves. When I put them on, the warmth of my hands released the scent of his cologne."

Wasser and I stare at each other in silence for a moment. He dips a blotter into the bottle of Cuir de Russie and waves it under my nose.

"The ghost in the bottle," he says.

N THE CALIBRATED WORLD of chemistry, a fragrance is a mix of oils in a 75 to 95 percent alcohol solution. Perfume has a concentration of oils greater than 22 percent. Eau de parfum has a 15 to 22 percent concentration. The less heady eau de toilette, 8 to 15 percent. The even more dilute cologne contains less than 5 percent oils.

The heart of a fragrance lies in the fraction of oils that evaporates off skin, hits the sensors in the lining of the nose, shoots up the olfactory bulb, and plucks a chord of delight in the mind. The traditional elements come from animals—musk (now replaced mostly by synthetics) from a deer, for example—and plants, most notably flowers.

In May, the season of roses, I visit Grasse, France. Surely the most celestial of roses is the rose de mai—the rose of May. The soil of Provence, mild weather, and blooms of Rosa centifolia, as it is known to botanists, conspire to produce an oil of exquisite delicacy.

"Like fine wine," says Joseph Mul, owner of 12 acres of rose fields near Grasse, snuggled in a valley between the French Alps and Mediterranean Sea.

Mul, a large round man with a beaming, equally rotund face, shows me his fields, where women are harvesting flowers. "The roses are picked as soon as they are ready," he says. "Not a second before or after."

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Aba Bulgu Dina is at

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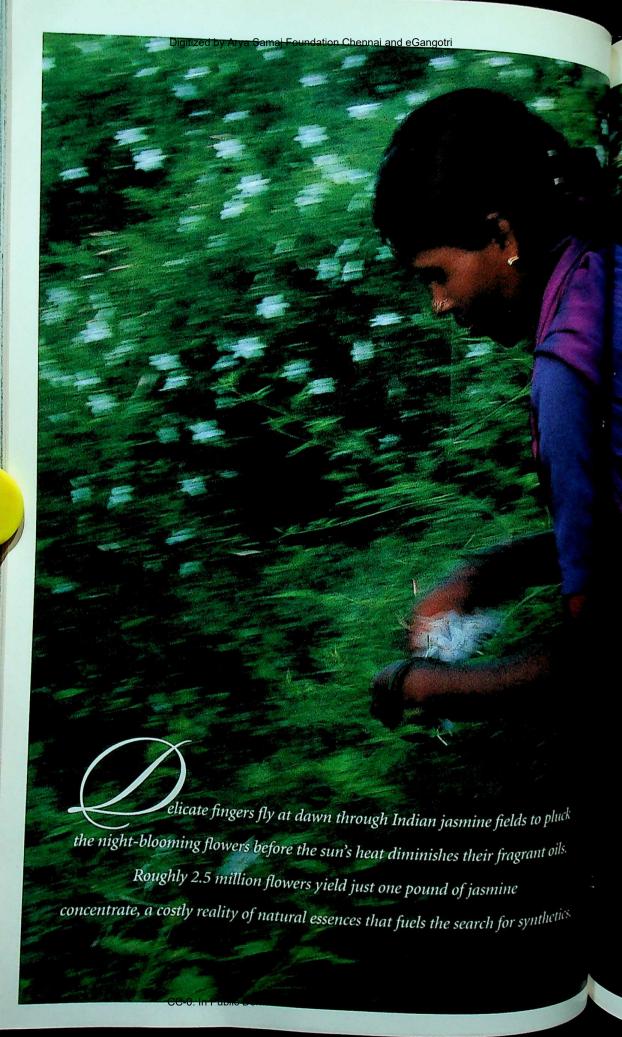
wood, felled in India

(below) and distilled it

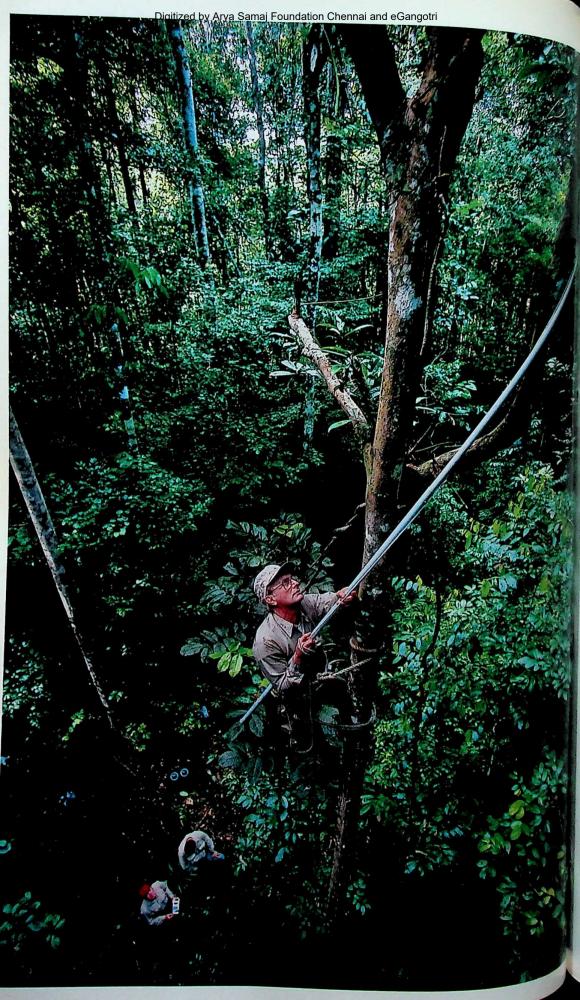
its sensuous oil.

He plucks a rose from a candelabra of branches. "Just opened," he says with a smile of satisfaction and hands me a pale pink bud. I tuck it in a buttonhole. "It takes 800 pounds of roses to produce a pound of concentrate. Unfortunately, this isn't a good year. Only six to seven blooms per branch. Sometimes we have as many as 25." Why? I ask.

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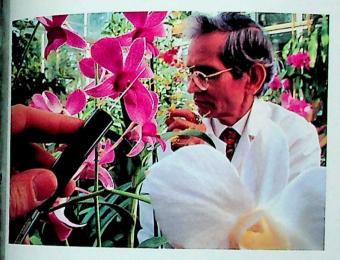
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"Weather. Spring was cold, and it hardly rained, which slowed growth. The harvest will be 20 percent less." He looks mournful.

It is ten o'clock. The sun has begun to wilt the flowers, marking the end of that day's harvest. "Picking roses will never be done by machine," says Mul. "Labor is 60 percent of the cost and makes the difference between the price of rose in Grasse and in Morocco. What I pay for a day's work here is worth a month's work there."

Just then, a gust of wind lifts the rose from my buttonhole onto the ground. Mul picks it up and flicks it into a burlap bag.

"I never waste a single petal," he says.



Joseph Mul's rose de mai absolute is \$3,650 a pound. Price of Moroccan rose oil is \$600. Once Provence was the source of rose, jasmine, lavender, and many wonderful essential oils. Today most raw materials come from developing countries. Land in Provence has become too costly for flowers. Condominiums and vacation homes sprout where roses once grew. High labor costs add to the burden. So the business has shifted to countries like Bulgaria, Turkey, Morocco.

So, too, jasmine. In 1975 nearly 412 pounds of jasmine absolute was produced in the Grasse region. By 1996 this had dropped to about 60 pounds (at \$12,000 a pound). Companies are switching to less costly (and less subtle) jasmine from elsewhere. Probably only three perfume houses today use French jasmine—Chanel, Guerlain, and Jean Patou. Cultivation of jasmine moved to Egypt, Morocco, and India for the same reasons roses moved.

Only one large field of jasmine remains in Provence. It, too, belongs to Joseph Mul, and its survival is not guaranteed.

"You must come back in September for the jasmine," says Françoise Marin, director of the School of Perfumery run by Givaudan Roure in Grasse. She hands me a blotter dipped in jasmine absolute. It is rich, lush, the evocation of tropical nights heavy with the scent of flowers.

She spoke of herself as a child of six, jumping in jasmine up to her waist. "Like landing in feathers," she says. "And the scent. . . ." A silence as the memory is conjured. "I cannot describe. The flowers themselves. Softer than silk. So fragile. You hold a bloom in your hand, and in a few minutes it turns brown."

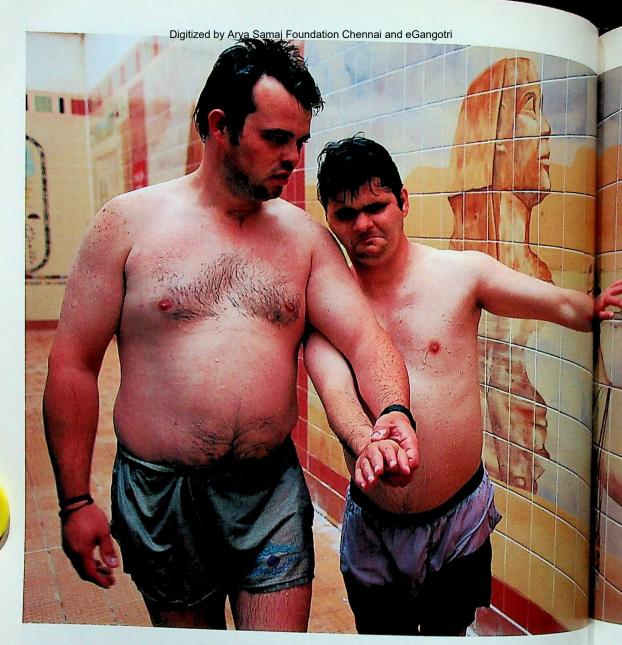
The next day we drive by the Saint-Donat Country Club, where manicured greens have replaced the jasmine fields. "You'd think they could at least call it the Jasmine Country Club!" Françoise remarks. Then past the tiny town of Plascassier, engulfed by bedroom communities for Cannes and Nice. "Rose fields once. And now. . . ."

A puff of air between pursed lips.

"You must come back for the jasmine," she repeats. "There is one field left. One only. In five, ten years it will be gone."

If it is, blame the dismal science of economics, for the exquisite scent of French jasmine will have vanished from the world of perfume.

n scent safari for supplier Givaudan Roure, botanist Scott Mori (left) probes a treetop bloom in French Guiana. An elusive new smell, like that from a rain forest orchid, can be collected in ^agreenhouse with devices like a glass fiber coated with an absorbent, used by Braja Mookherjee (above) at International Flavors & Fragrances (IFF). The essence can then be chemically analyzed and synthetically re-created. Capturing scent, says Mookherjee, "is a divine business."



ET US DISTILL THIS TRADE in essential oils down to the sound of the phone ringing in Dominique Goby's office in Grasse. His phone is almost always ringing. It may be a Japanese client asking about the price of patchouli, an herb ("it will fall"), or a German client asking for a sample of lavender ("on the way").

As sales and marketing director for Systems Bio-Industrie, a seller of perfumery oils, Goby watches some 60 different materials rise and fall in price. "Right now I'm setting up my campaign for rose oil," he says. "This year the price of roses in Morocco increased 20 percent. A short crop. I may have to set quotas for our clients."

His worries are weather: "A typhoon in Réunion may ruin the geranium crop." And politics: "Take galbanum, a gum from a plant growing in Iran. When the ayatollah came into power, the market collapsed."

Sometimes a small shortage translates into sheer speculative fever. "In November patchouli oil was \$10 a pound. By April it had climbed to \$30 a pound." He showed me a chart that looked like an EKG. "Of course, it will drop again. Probably by June. I tell clients: Wait if you can."

But the business of perfumery can't afford to wait out the vagaries of politics, weather, and speculative fever. Thanks to synthetic materials, it

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Brailey, at right, and a Wednesday, he snels aroma of lemon—and knows that swimming the local pool is on to the day. Andlaw House therapeutic facility in Exeter, England, circular a different fragrance and day of the weeks one of several sensory.

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NATIONAL GEOGRAPHIC, OCTOBER 1999



to help impaired residents like Nigel, who is deaf and blind, navigate the day. Signing, familiar objects, ^{and} helping hands also reinforce the routine. ^{*Being} able to anticipate what's coming next is almost a basic human right," says education ^manager John Shaw.

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doesn't have to. In the 1930s, says Geoffrey Webster, president of fragrances worldwide at Givaudan Roure, a perfume might be 85 percent natural, 15 percent chemical. Today it's the opposite. Before 1890 perfumes were totally natural: simple floral waters with names like Coeur de Rose. "Figurative perfumes," Yves de Chiris of Quest calls them. "The advent of synthetics allowed impressionism in perfumes," he says. Instead of a photograph of water lilies, think of a Monet painting.

Synthetics also allow the replication of scents that do not extract well, such as lilac. They allow the use of scents from flowers too rare to be picked, or products like musk that involve the killing of a wild animal. "Good fragrance is a balance between naturals and synthetics," says perfumer Harry Frémont. "Naturals give richness and roundness; synthetics, backbone and sparkle."

TO MAKE A PERFUME, take four or five or hundreds of ingredients, known as notes, and add one perfumer. First of all: notes. The world of perfumery uses about 2,000 notes, but many are simply variations on a theme. There are light, sparkling citrus notes like lemon or bergamot. Dark, resiny notes like balsam or olibanum (frankincense). Fragrant, woody notes like sandalwood or cedar. Bracing, herbal ones like lavender or basil.

There may be 20 rose notes to consider. Do you want Bulgarian, Moroccan, Turkish, or French rose? A rose synthetic like rhodinol, perhaps? "Choosing a note is like picking a color, say blue, then picking a shade in that color," says Steve DeMercado, a perfumer with Givaudan Roure.

The perfumer acts as composer. The arrangement of a perfume is not unlike a three-part fugue. The part of a perfume known as the top note, or head, spins off the skin immediately; it's a fanfare and vanishes in minutes. The middle note, or heart—compounded of heavier materials that last for hours—sets the theme. The base note, or dry down, gives depth and, like a resonating chord, can persist for a day or two.

"You dream your perfume before you write the formula," Jean Kerleo says. Kerleo, a courtly, graying man, is chief perfumer for Jean Patou. "You begin as a composer. You finish as a sculptor."

"And you have to be crazy in a way," adds Sophia Grojsman. On the day I visit her in New York City at IFF, Grojsman wears a black-leather skirt bisected by a huge metal zipper, tottery black high heels, and black stockings. As IFF's star perfumer, she has blockbusters like Eternity, Trésor, and Paris to her credit.

An assistant walks in. "He wants wild meadow number four, five, six," she says. Translation: An evaluator wants to see three new versions of a scent in progress. Right now.

"I don't believe it," Sophia says, hand on forehead. "Insanity. . . ."

She leans forward conspiratorially. "I am going to close the door and do something illegal. I am going to light a cigarette."

But doesn't the smoke affect . . . ?

"I bypass it," she says, brushing off the question as if it were a stray ash. "I go right to the heart of a fragrance. Some people smell top notes first. I go deeper. I search for the soul."

An assistant scurries in with two blotters. Sophia waves one, then the

other, briefly beneath her nose. A pause.

"I like the new one better."

The assistant looks relieved.

Digitized Waya Samay Foundation Chennai and eGangori Colopatiu

Perfume is pure seduction.
Cleopatra, Queen of the Nile,
received the Roman statesman
Mark Antony on a barge with
sails soaked in perfume. Incense
burners surrounded her throne
with an intoxicating cloud. The
Egyptian queen likely wore
something similar to the
unguent in the Roman

something similar to the unguent in the Roman flask at left. The scent was reconstructed from ancient formulas by the late Giuseppe Donato, a chemist associated with



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the Institute of Cultural Resources of the National Research Council of Italy and perfumer Giulio Arippa of Chimifar in Genoa. Its ingredients are costly resins like balsam and myrrh, spices like cinnamon and cardamom, and iris row. lotus, saffron, and marjoram. Women in ancient Rome were massaged after the bath by slaves who used a different fragrance for each part of the body, and people perfumed their hair, their garments, even the soles of their feet.

"I live with these fragrances days, months," Sophia continues. "Iput them on in the middle of the night. My husband will say: Can I smell But the public is what I count on. Taxi drivers are the best. Once I was working on something very sexy, very spiritual; I get into a cab wearing it, and the guy's like: 'I can't drive. I can't drive.'

"I build my fragrances from bottom to top. Like a pyramid. In layer

It's geometric. The art closest to what I do is music."

"Compare your perfumes to an opera," I ask. "Which would it be? A deep laugh. "Carmen. I want every woman to be mysterious and ardent. I have this urge to be alive. To be somebody. I'm a Gypsy by nature. I am Carmen."

RETURN TO FIRMENICH to check on my project, the Cathy perfunction Cathleen Montrose hands me a box with eight different small bottles of perfume. My impulse: Spray them all on at once, but Cathleen says, no, wear one each day, and keep a perfume diary.

The perfumers offer advice. Annie Buzantian explains that you real can't get an idea whether a perfume works or not until you wear it. "Like the difference between a dress on the hanger and a dress on body." Harry Frémont says the first impression is often the right one. "You can overthink a perfume," he tells me.

Each day I wear one fragrance. At night I record my impressions, heady. Too romantic. I feel like an imposter, I write of the one labeled Mirage, a submission so elegant it makes me feel hopelessly awkward. As soothing as a cashmere shawl, but too sweet, I note of Wraparound.

To smell the historical fragrances on these two pages, use your finger to swipe—do not scratch—the colored part of the bottles. Friction and heat from your hand will release the perfume oils, which were encapsulated in a special polymer to form droplets five to seven microns in diameter—about a tenth as wide as a human hair. The encapsulated droplets of perfume oil were then mixed with a lacquer and printed on the page.

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CLEOPATRA: DETAIL FROM AN ENGRAVING OF A PAINTING BY LEON GERÔME: NAPOLEON: PAINTING BY JACCOUES-LOUIS DAVID. BOTH IMAGES FROM THE GRANGER COLLECTION, NEW YORK CITY. ART BY WILLIAM H. BOND

THESE SCENTS

Napoleon loved cologne. A flask of scent tucked into his boot masked the stench of war. He used a bottle or two each day and placed an order shortly before his defeat at Waterloo in 1815. But in exile on St. Helena in the South Atlantic his life as emperor of France dwindled to a memory. Memories, at least, can be retrieved. His valet on St. Helena, Ali, procured a formula for Napoleon's cologne and compounded the scent from ingredients like lemon and rosemary that grew on the



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island. That fragrance appears in this crystal bottle topped by a stopper with Napoleon's bust. Years later Ali's belongings were auctioned. The formula for the scent was brought to the Osmothèque, a museum of fragrance in Versailles, by André Damien, a former mayor of the city. In 1992 Jean Kerleo of the French Society of Perfumers was asked to remake it. After a month of trials he held Napoleon's cologne. "It was a very moving moment," he says.

Exotic, hypnotic, like a walk through a suq, I say of the irresistibly named Metaphor. But, too weak.

I mail my comments, embarrassed by my fussiness. Does my fickleness offend the perfumers? Of course not, Cathleen assures me, when we talk. Their job is to please the client.

The battle to hook the customer culminates at the counter. "A customer must fall into a fragrance immediately," says Yves de Chiris. "Any hesitation and you lose."

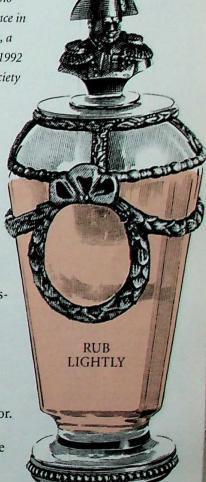
I visit Sephora in Paris. A store of polished granite, chrome, and glass. Retailing as theater—an electronic ticker tape flashes the price of Chanel No. 5 or cK One in New York, Buenos Aires, and London. Salespeople wear head-to-toe black. Even the pens they hand you to sign yours.

sign your sales slip are black and sleek. It's all so chic. So hip. To die for. Hundreds of fragrances sit on shelves, a fraction of the thousand or so brands on the market. With more—many more—to come. The launched in the United States last year. In France, even more.

"It's a 'what's new?' business," says Ann Gottlieb, a New York consultant, who has shepherded about a billion dollars' worth of fragrances disposable era. This is a generation with a short attention span." The three years to I his big, move on. Two decades ago scents took one, two,

three years to develop. Now, they're done in months.

And they drop like flies. Of ten launches, maybe two will break even, seven will fold, one might succeed. An expensive gamble:



It can cost 20 million dollars to introduce a new scent.

Why bother? For the money, of course. Big money. Take Klein's cK One—250 million dollars' worth shipped its first year out—or a classic like Chanel No. 5, which according to consultant Allan Mottus has rung up more than a billion dollars in sales over 75 years.

Spectacular ups; spectacular downs.

One corpse left by the wayside was the 40 million dollars reportedly lost on Christian Lacroix's C'est la Vie in 1989. Other sinking ships: perfumes by Cher, Sophia Loren, and Pelé. Even Kermit the Frog put his webbed imprimatur on a fragrance: Amphibia, a scent with "green" notes. It lasted a year.

Then there was Armani's Giò: a multimillion-dollar fizzle.

What went wrong?

It certainly wasn't the launch party. *Tout* New York and Hollywood showed up. Guests crowded a Manhattan office basement reconstituted as a Moroccan palace. They ate off Moroccan brass dinnerware under 10,000 square feet of muslin tent. They sipped mint tea and champagne in the shade of palm trees. Cost: about a million dollars.

"As much as we try to be analytic, study trends, and market test, at the end of the day it's a crapshoot," says one marketing director.

Does the world really need a new fragrance?

"Yes," says Patrick Firmenich, vice president of Firmenich. "The world needs a new fragrance the way it needs a new sculpture or painting."

"Certainly not," says Vèra Strübi, president of Thierry Mugler Perfumes. "Unless it can be creative and different."

BOB ALIANO is hoping that PF1 (Prestige Fragrance number one) will be creative and different.

"It's the battle of the Titans," he tells me. A big man with a shiny helmet of black hair and toothbrush mustache, Aliano, vice president of creative perfumery for Giorgio Beverly Hills, explains that project PF1 has come down to a runoff between Firmenich and IFF. Suppliers like IFF and Firmenich may spend a quarter of a million dollars to create a fragrance like PF1 on spec, with no guarantee they'll win the contract to supply the "juice," as the scent is known. It's win or lose. There is no second place.

"When you lose a competition for a fragrance, do you say, 'It's just a perfume'?" I ask Thierry Wasser, the perfumer at Firmenich. He frowns.

"Just a perfume. Just a perfume. That's my hope, my life, my self in that bottle. It's why we're here from seven in the morning to seven at night. *Just a perfume!* When you lose a competition, you kill hope. And when you open the bottle, a bit of us flies out."

IFF, where I am now, is gambling on a submission based on an orchid note. The scent of the orchid, a rare golden bloom that grows in tropical Asia, has been re-created in the lab. Across town, Firmenich is banking on a scent built on a merlot wine note.

Aliano explains the concept: "A perfume so beautiful men will miss you when you leave the room. To sell for \$300 an ounce. Maybe more. The sky's the limit!"

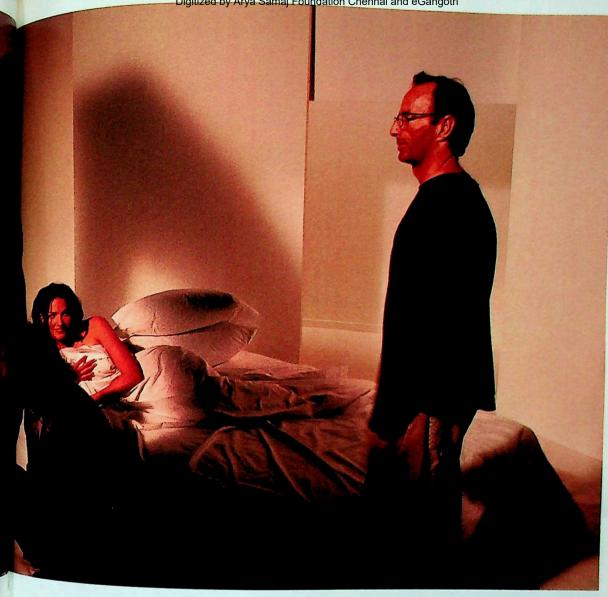
Braja Mookherjee, IFF's vice president and director of natural product research, enters and announces he has discovered several new molecules in the orchid note. New molecules! Bob perks up.

"That's the story," he enthuses. "Never before smelled by humans."



can net millions a year

in sales.



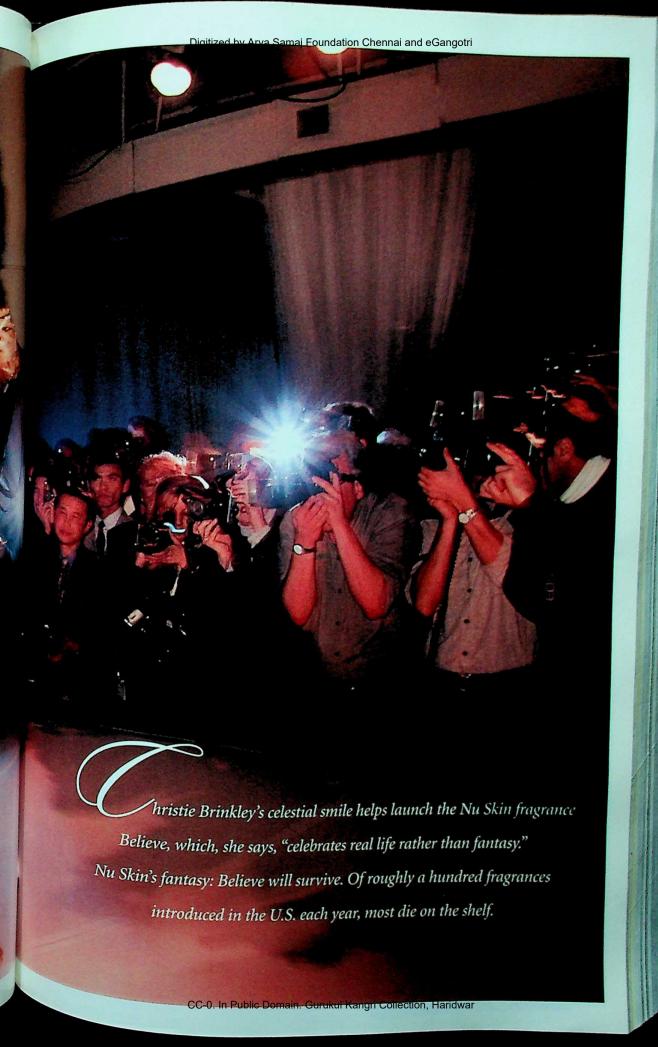


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The words tumble out nonstop. He's speaking in exclamation points. "We took nothing away from nature but the air! You'll never smell anything like this in your lifetime!"

Sophia Grojsman, the perfumer on the project, sprays a bunch of blotter cards with different submissions and passes them out.

"Number two is muted," she explains. "Seven adds coconut." She sniffs the blotter. "Maybe a little too much coconut."

Aliano likes number five. All heads nod energetically. "I want it

bigger, bolder," he says. "I want to make a statement that this is the best. It breaks all the rules. It's PERFECT!

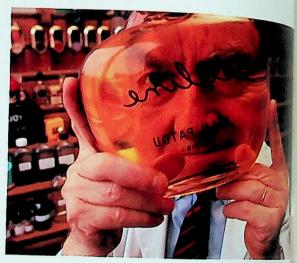
"In fact," he adds, half to himself, "'Perfect' may become the name."

In July, I call Aliano to check on PFI.

"He's no longer here," a secretary says. "He left ten days ago."

I track him down. "I took a golden parachute," he says wearily by phone from California. "I'm sort of tired of this whole industry. Not the creative part," he quickly adds. "It's the strictly numbers attitude. The testing a thing to death. The layers and layers of people.

"PF1 just wasn't going to happen. I hear they've canceled the project."



ARKETING FIRST, then fragrance.

"This is craft, not art," perfumer Annie Buzantian says pragmatically when I ask if the market-driven nature of the business bothers her.

The siren song of advertising leads us to the counter. Last year the industry spent 400 million dollars to trumpet the product. In the never-never land of perfume advertising, the dogs (invariably golden retrievers) never have fleas; no dirty laundry piles up; the grass never needs cutting; there are no pimples or bad hair days. Even the beads of perspiration on the finely muscled torsos look as if they smell not of sweat but of the scent being pitched.

Surely the genius of sell is Calvin Klein. Consider the ads for Obsession: a tangle of bodies (two men, one woman . . . or is it the other way around?). "Repulsive," says a competitor. "But they stick with you. We spent seven million in advertising our product, and in a focus group women said they'd never heard of it."

The Calvin Klein fragrance empire reigns on the 22nd floor of Trump Tower in New York City. I talk to Sheila Hewett, vice president of marketing and advertising.

"The hardest thing is to take something people don't need and make it part of their lives," she explains. "How do you get their attention? You scream loud. You read trends. You look at what's happening."

Take the Gen Xers: target market for cK One and cK Be. "They're wearing fragrance to be part of the group," says Hewett. "They're from divorced families, so friends become more important. There are no rules. It's assimilating to an attitude."

To sell to this group, "you ask what are they reading, what are they

ehind every perfume is a great now One of the best is Jean Kerleo (above), perfu for Jean Patou in France "You have to dream and fume, imagine it, and have its odors in your mind," says Kerleo, has memorized hunde of natural and synthic raw materials. "It's fall ulous to create some that will seduce." For collector Christie Man Lefkowith of New York City, owner of the flat at right, the seduction begins with the bottle.



driving? It's anthropology. You create what they want almost before they know they want it."

The buzzword is global. Flat sales in Europe and the United States prompt a scurry to new markets. Eastern Europe, China, and South America are big. Saudi Arabia has perhaps the highest per capita use (more than a quart a year). Japan is a longed-for market, but a head ache. "The Japanese give a status-symbol perfume as a gift. Then it is on the shelf," frets an executive.

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In this global arena the two big players and rivals are France and the United States.

Where is the center of the fragrance universe?

"Paris," says Patrick Choël, general director of Christian Dior Parfums. He sits in a lipstick red leather Le Corbusier chair in his Paris office. "Americans are safe, not experimental," he says, softly and very very fast. "When you look at some of the successful American brands you get a lot of crap. We are Dior. We cannot be like that. We are self-the ultimate French good taste."

Dominick Anastasio, president of Fashion Fragrances & Cosmetics,



downs a swallow of coffee in the Edwardian Room of New York's Plant Hotel and counters, "The French lost their derrieres after World Ward They refuse to accept that 'Made in France' means almost nothing except to a few women anymore."

At a 1995 industry conference in Grasse the tug-of-war erupted in public. The Americans went first and spoke of positioning and how well they understood the global market. The French, just as stridentical claimed they were the center of creativity and experimentation. After much puffing from both sides, Serge Lutens, a makeup designer who has an exquisite perfumery in Paris, got up to speak.

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NATIONAL GEOGRAPHIC, OCTOBER

He spoke of mysteries and secrets: the soul of perfume. He spoke of how in Morocco you can get drunk on smelling roses. Of Marie Antoihow in the carriage—the people knew it was she by the scent of her carriage passing in the street. Of Cleopatra and myrrh, and how you can tell the whole of human history through perfume.

Afterward a perfumer stood up and said: "At last, someone speaks of

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So let us speak of perfume and a fragrance so wonderful you fall deeply into it. Let us speak of a perfume so beautiful men will miss you when you leave. Let us speak of perfume and a magic that beguiles us into believing our dreams will come true.

In October I visit Macy's in Manhattan, where a new cologne is to debut. Sally Yeh, president of Bijan Fragrances, the company marketing the scent, inspects the layout, making sure everything is just so.

The product about to be unveiled epitomizes the fragrance-asaspiration approach. It's Michael Jordan cologne. Where's the face behind the fragrance, the basketball baron Michael Jordan? "He can't do store appearances; he'd cause a riot," Sally explains.

But he's done the media—Oprah, David Letterman, among others, who have flashed the bottle with its sneaker-tread base at the camera. Many jokes from Letterman about the smell of sweat, but, in truth, it smells citrusy and fresh.

Throughout the PR blitz, Jordan smiles his multimillion-dollar smile. Why not? Profits from the sales will make more multimillions.

Seven fragrance models, recruited for the launch, are armed with cologne and poised for action. "Try Michael Jordan cologne. Michael in a bottle," they coo.

Some shoppers brush them off; some offer their wrists. As the day progresses, a woman stops when approached by one of the models, a tall, handsome young man with a majestic tangle of braids.

"Only 23 dollars," he teases.

"I don't have a man to give it to," sighs Denise Gordon, a teacher. "Don't wait for a man," he urges.

She coolly looks him up and down, then says: "Put some on, baby, and let me check it out."

He obliges, and before you can say personal foul, she grabs and whirls him around the aisle, her face lit up like a Broadway marquee. For a Cinderella instant the store is transformed into a ballroom.

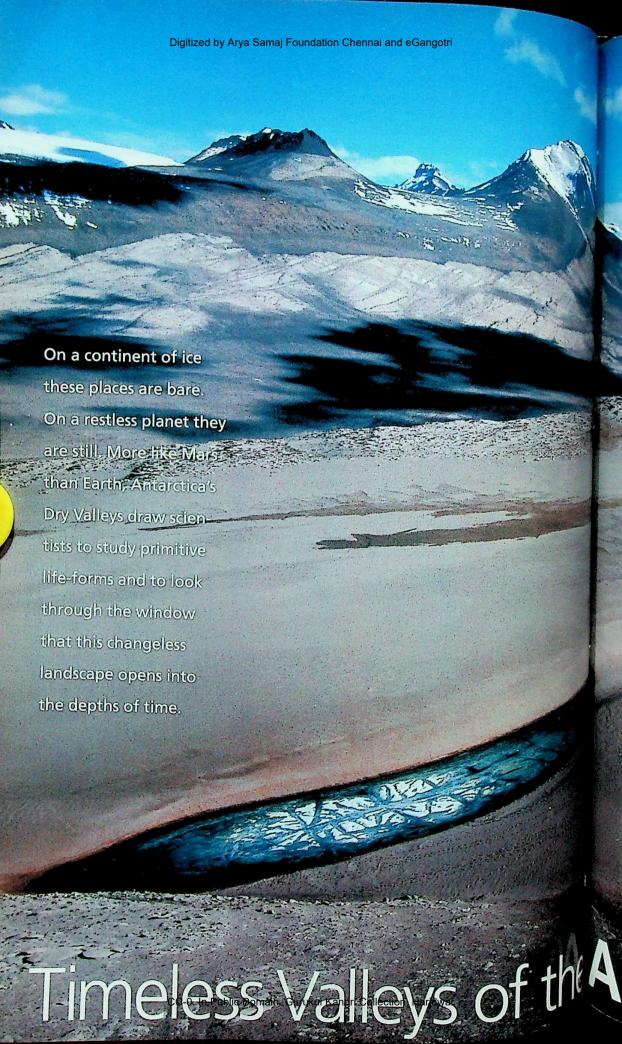
IX MONTHS after beginning the Cathy perfume project, I meet Ann Gottlieb, the consultant, for lunch and hand her Mirage. She sprays it on her wrist, sniffs, and after a pause says: "It's right on trend. Approachable, pretty, yet doesn't scream." She looks at me. "How do you feel about it?" Like an imposter, I respond. It's too pretty. "Ah," she says. "It's aspirational."

Does the world really need a new fragrance? perhaps. Held up against the sad weight of the world, perfume can ultipast like against the sad weight of the essence of illusion Seem ultimately frivolous. A whiff of costly air. The essence of illusion.

Viewed against that same sad weight, perfume can be wondrously evocative. An elixir to make us forget. Or remember. Or dream.

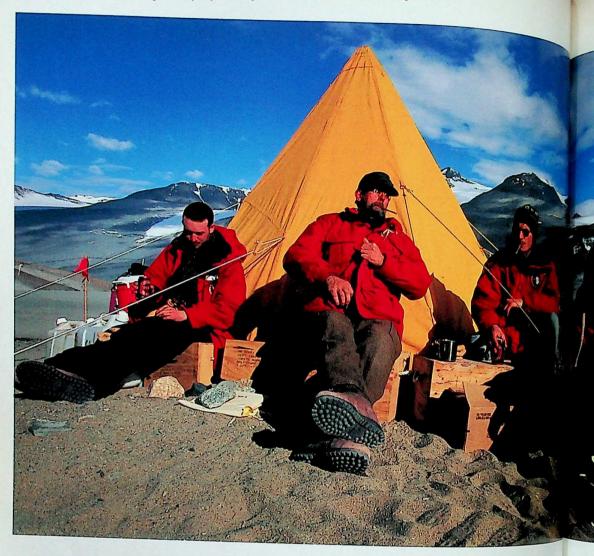
rom the sublime ... to the canine: Parisian groomer Marie Cavalieri D'Oro spritzes clients' dogs and her own Pacha with Chien Chic de Paris, one of many dog perfumes. "It's very gentle, and a pleasant surprise for the owners," she says. Such non-scents were likely not the inspiration for the poet Baudelaire, who wrote of "perfumes fresh as children's flesh, soft as oboes, green as meadows ... possessing the diffusion of infinite things."

Learn more about perfume at www.nationalgeographic.com/media/ngm/9810.



Digitized by Arya Samaj Foundation Chennai and eGangotri

Antarctic Desert



By MICHAEL PARFIT
Photographs by MARIA STENZEL

drinking scotch out of a metal cup, smoking a cigar, and grinning a wicked grin. He looked like a young Fidel Castro celebrating victory, but what pleased him was not revolution but time. "No trees," he said. "No green plants. Just blue-green algae. Where else can you go where it's just like it was three billion years ago? Incredible!"

Marsh, a Johns Hopkins University geologist, was camped with four colleagues and me on a gravel shelf below a hillside covered with rocks shaped by wind into what looked like

MICHAEL PARFIT, a frequent contributor, is the author of South Light: A Journey to the Last Continent. MARIA STENZEL first learned about the Dry Valleys when photographing Antarctica's sea ice for the May 1996 issue.

enormous skulls, above a valley in which were scattered freeze-dried carcasses of seals. The had crawled up here by mistake from nearly McMurdo Sound and had died as long ago so 3,000 years. Yet what Marsh found incredible was not the vivid strangeness of this little pieze of Antarctica called the McMurdo Dry Valles but the way this place uses a kind of amber of coldness and dryness to catch the traces of time.

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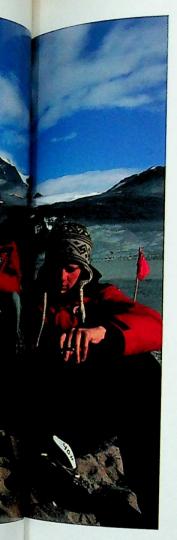
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Ninety-eight percent of Antarctica is covered with ice up to three miles thick. Most of the percent left is made up of mountain peaks as sea-scoured coastlines. The Dry Valleys are different. The name applies to a region includes about 1,500 square miles of ground, which, because winds blast away should and keep precipitation out, doesn't build the area is dominated by three parallel valleys.

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Collection, Haridwar NATIONAL GEOGRAPHIC, OCTOBER 1935



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"It takes a while to get at ease in this place," says Johns Hopkins University geologist Bruce Marsh, second from left, resting in camp with his student team after a day of gathering rock samples. "We never see formations so sculpted by wind anywhere else on Earth," he says. "For geologists it's all very odd, until you understand that this is very ancient terrain."

Victoria, Wright, and Taylor. There are several large lakes in these valleys and a number of ponds. Many are frozen clear to the bottom, though one has 77°F water deep below its tenfoot-thick ice ceiling, because dense layers of salty water trap the slight summer heat. A single 18-mile-long river flows with glacial melt for one or two months each year. The average annual temperature here is minus 4°F, and the than four inches of water a year.

Every Antarctic spring, even before the sun lifts clear of the horizon for its three-month-scientists like Bruce Marsh, brought here by the hations' research organizations, converge on the Dry Valleys. There is much to draw them:

Microscopic worms at the top of the food chain, life that survives being freeze-dried, great slabs of rock that would elsewhere be hidden to geologists by plants, evidence of the history of the climate hidden in the ash of ancient volcanoes. But the different scientists share one thing—this stark place, which has changed little in millions of years, gives them a chance not just to check out a curious part of the Earth but also to explore the far reaches of time itself.

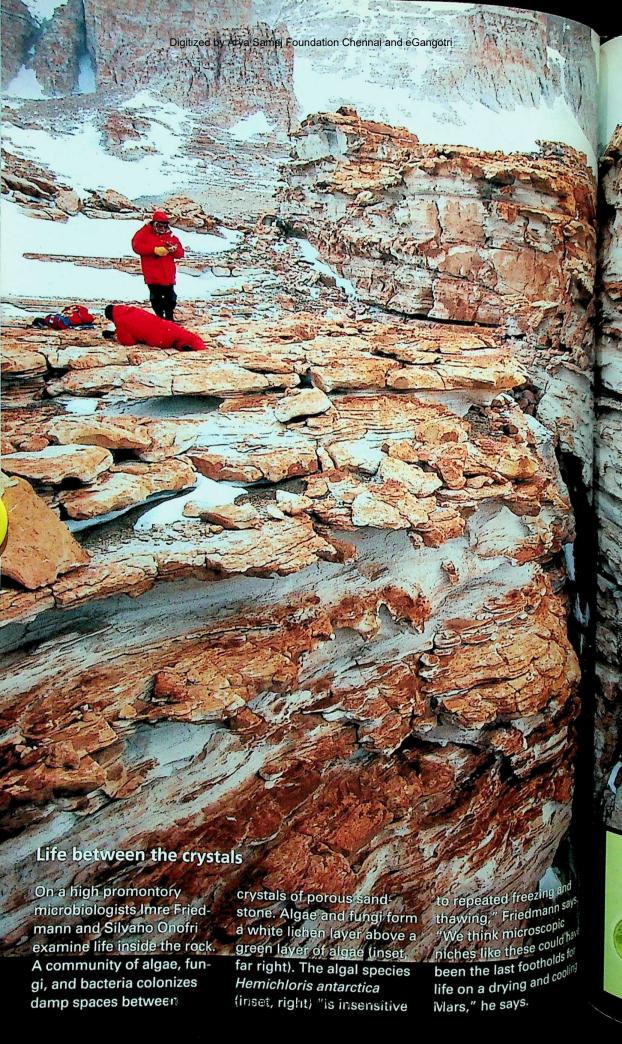
"Rocks are the history books of the planet," said Marsh, pausing in his climb up a slope of broken black basalt. "Everywhere else you get rain and decaying plants, and the rocks get altered. Here the rocks have been kept cold and dry, and they're just like the day they were formed. It's like walking into a beautifully maintained Alexandrian library from 100 B.C. The same kind of thrill."

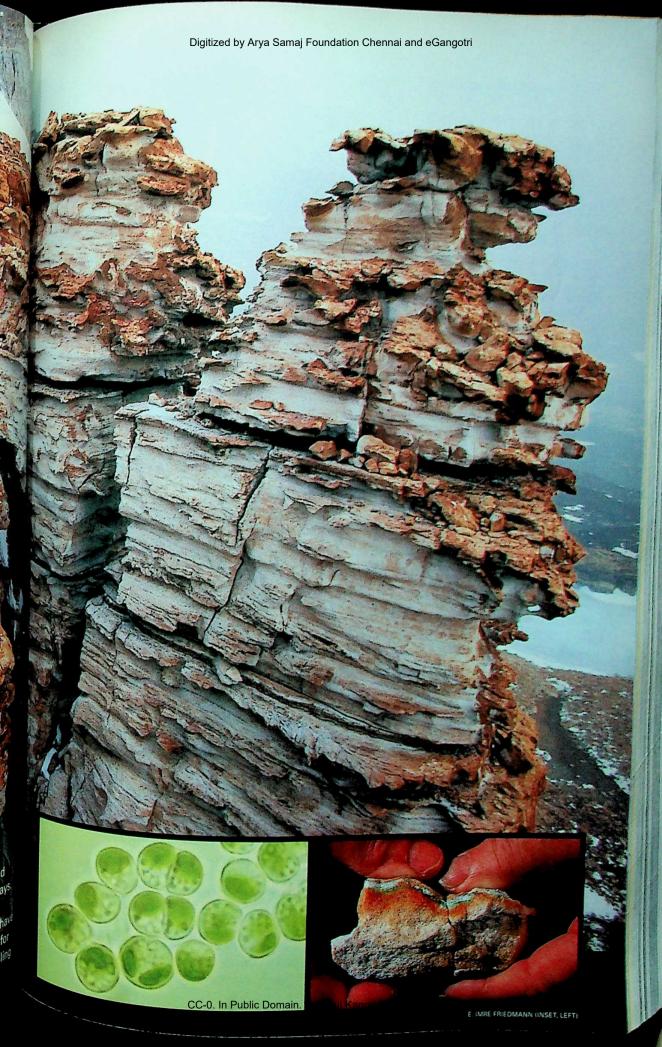
The six of us were working our way up a steep hillside, taking chunks from a band of stone that had been formed from magma deep in the Earth about 180 million years ago. As usual the view around us was spacious and grand: Below us lay a stony valley that swept far out and upward to ridges of pale brown and black layers of rock. Beyond that the luminous whiteness of the East Antarctic ice sheet flowed right up to the ridges that surround the Dry Valleys like a reservoir lapping up behind a dam. The cold air was so clear it was hard to imagine there was a single molecule of anything in the sky between us and the South Pole.

Marsh chopped a chunk off a boulder and put it in his pack, which was already about 30 pounds heavier than when he started. What he wanted to learn from this load went much farther back than just 180 million years. He was trying to understand the basic processes that made the planet's surface.

Marsh, who loves to explain his complex science with everyday metaphors, now talked about walking through an automobile junk-yard: If you didn't know what cars were, he said, you'd have a hard time figuring out just what all those pieces of metal had come from. To geologists, most of the world is the junk-yard, hard to interpret. But in the Dry Valleys you can tour the whole factory.

"There are rocks just like this at Gettysburg, Pennsylvania," Marsh said. "But we can't see much of them. The very completeness here allows us to flesh out the overall scope of





how volcanoes and magma work in the Earth."

The long story that Marsh seeks is not just for geologists. Those who study life can find some of the oldest living things on Earth and some of the most ancient species.

One collection of unusually old—and tough—species was discovered in the mid-1970s by microbiologists Imre Friedmann, from Florida State University, and Roseli Ocampo-Friedmann, from Florida A&M. On a ridge above the Victoria Valley they found an entirely unexpected community of microscopic algae, fungi, and bacteria living *inside* rocks.

These microorganisms live in the minute gaps between the grains of sandstone, about a sixteenth of an inch under the surface, where they can get a little light, a little moisture, and a little sustenance from the mineral that encloses them. The tiny fragments of life can be thousands of years old, more ancient than the greatest of trees in the oldest forests. That does not necessarily indicate that they are thriving.

"They're always cold, always hungry, like families living in the gutter," Friedmann said. "They live in continuous misery, so to say. They're near to the absolute limit."

So is everything that lives here.

"This is a pretty extreme place for life," says Robert Wharton, of Nevada's Desert Research Institute. Wharton ran the McMurdo Dry Valleys Long Term Ecological Research project, which incorporates much of the research being done here into an overall framework designed to make the information gathered useful in predicting things like climate change. "If you turned the thermostat down just a little," Wharton said, "everything would freeze up. We're exploring the outer reaches of life."

To do this exploration, scientists go to extremes themselves.

"Sometimes you participate in something," said Nick Lancaster, in his deliberate British accent, "and you think: I don't want to do this."

Lancaster, also from the Desert Research Institute, was standing at the edge of a hole in the ice of a small lake, drawing rope out of the water. The rope was stiff as cable, frozen as soon as it emerged. At the end of the rope was Dale Andersen, doing the chilling job that Lancaster, here to study wind erosion, did not envy.

Andersen, a diver working for Bob Wharton's project, seemed to love it. He was on the bottom of the lake, 70 feet down, wearing a dry



suit and scuba gear, gathering algae sample. He was apparently impressed with how big growth was, and how little of it he could go into his sample bottles. His excited voice care gurgling up to us through an intercomplish mask.

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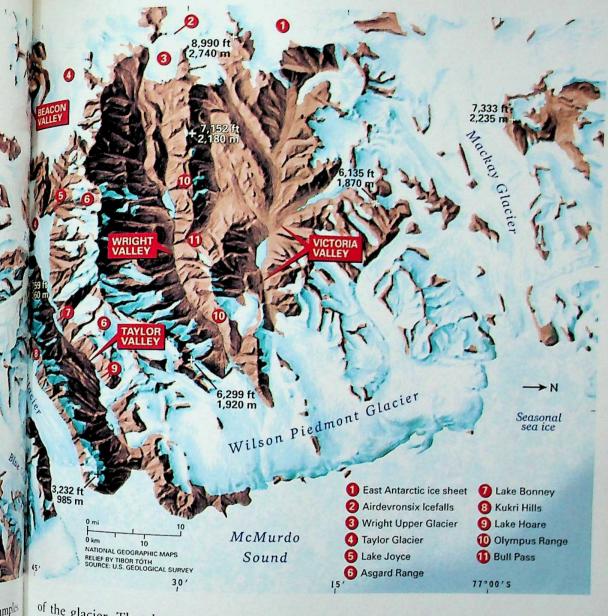
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"I'm going to put three of these things."

gasp . . . in the bottles," the voice said. "These are just the babies."

The lake was called Joyce and lay in one the most spectacular settings I have seen all where. On one side of the lake was a wall of a glacier that flowed down into the Taylor ley from the continental ice sheet above. Further where around us dark bare rock rose in violence peaks, ridges, and pinnacles. Everything jagged, except for the line drawn by the sufficient collection.

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of the glacier. That long simple edge, which seemed to glow with all the light the sun could give it, was a smooth white curve miles long, the Earth.

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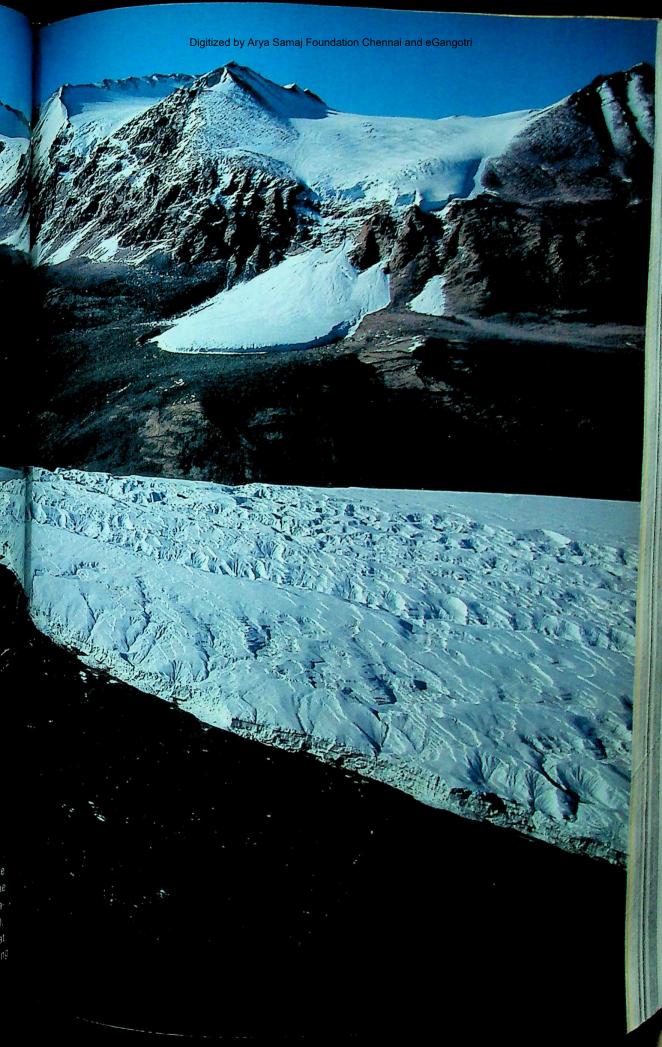
Over several years Andersen had been diving in the lakes here. Each one looked much the same on the surface—sheets of ice that thaw slightly around the edges for a short time each small amounts of groundwater and seasonal melting of glaciers, has a different chemical are salty, but in varying degrees. One pond has than Utah's Great Salt Lake—that it doesn't drop to 60 degrees below zero.

Until 1978 most scientists thought the lake bottoms were almost barren. "They said you're not going to find anything but rocks," Andersen remembers. Then George Simmons, a National Science Foundation grantee, decided to dive to the bottom of Lake Hoare. Andersen, working for Simmons, was there.

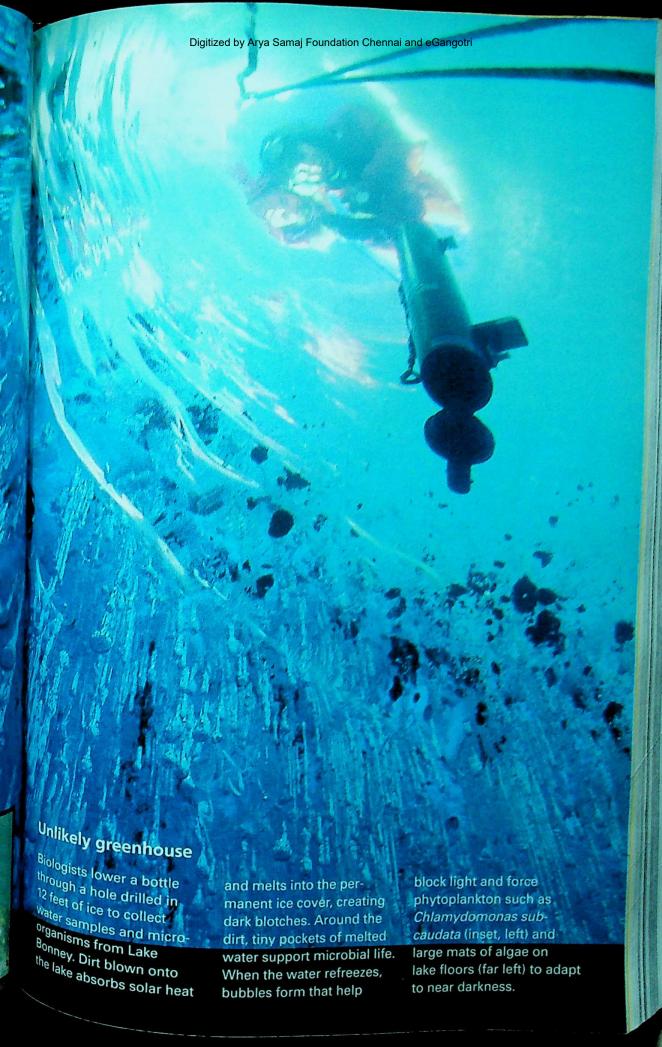
"I'll never forget it," Andersen said. "He got to the bottom, and his eyes got used to the darkness, and he started shouting over the intercom: 'Mat! Mat! Mat everywhere!' We thought he was in trouble."

What Simmons was talking about was bluegreen algae, a primitive form of bacteria. The algae—which can be orange or black as well as blue-green—live in what scientists call a microbial mat, a community of many species. These kinds of (Continued on page 132)









algae are some of the oldest life-forms on Earth; they are thought to have been one of the original sources of the oxygen in our air. Yet they're hard to study elsewhere, because in most other places mats like these must compete with other organisms. As with Bruce Marsh's geology, the uncluttered starkness of the Dry Valleys allows an unusually close look.

"There are few places where you can find strictly microbial mat communities like this," Andersen said. "It's like diving back in time."

Algae have various ways of dealing with the Dry Valleys' slow, harsh chronology. A few years ago Diane McKnight, an ecologist with the University of Colorado at Boulder who studies algae with Wharton's group, wondered if some of the algae could survive a long time without liquid water. This question not only is germane to our planet but also could relate to the question of life on Mars, which the Dry Valleys resemble more than many places on Earth. So McKnight built a sandbag dam across a stream to run water into an old channel.

"In 1969," McKnight told me as we followed the water, "aerial photographs showed water in this channel. By 1981 more photos showed it was dry." When she walked down the channel before turning water into it, there were only a few pockets of very dead-looking algae.

When the languid stream moved back into the dry channel, McKnight held her breath. Some of her colleagues questioned whether the experiment was worthwhile, and as she waited for something to happen in the water, she wondered if perhaps they were right.

There were plenty of other indications that life has developed extraordinary strategies to survive here. Diana Wall, a Colorado State University biologist who studies nematodes—microscopic worms—found that they go into a dry, lifeless state called anhydrobiosis when moisture leaves. Dried out, they start to look like night crawlers on the driveway when the puddles go away, except the nematodes are not exactly dead. When the tiny bit of wetness from a light snowfall or a brief melt comes along, the nematodes emerge from their freeze-dried state and go back to eating bacteria.

"It's like the fountain of youth," Wall once told me with a grin. "You just go into anhydrobiosis and wait."

McKnight knew about her colleagues' work with other life that survived long periods of dry

cold, but she remained unsure what to experiment. She didn't have long worry. Only a week after the water had be turned into the old channel, telltale oranges black colors burst forth along the watercourt

Was this how life had hung on in the earlier Earth's harshness? Was it how life might possibly still survive on Mars? Those were specific tions for another kind of study. Right now was enough that these algae, which had looked like dust, were practically in flower.

McKnight and I stood beside the easy flower the stream, looking at the stain of life along wet rocks.

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"I guess I hadn't gone out on a limb as much as I'd thought," McKnight said.

To me it was life itself that seemed out or a limb here. I thought about these same kind of algae getting established on the early face of Earth, in places that may have looked a lot like this—bare rock, parched sky, and not much hope of anything better for a billion year. I thought of the hills near my home, no completely covered with abundant green, a because stuff like this stain on the rocks hurse on through the hard times. We come from stubborn stock.

McKnight and I walked quietly back toward her camp next to the stream. Beside us the water slipped down toward the lake, sparking in the sun, awakening elemental life, as if it held in its miraculous fluid the gathered light years of a million stars.

HE MORE PEOPLE LEARN about the deceptively simple-looking place, the more complexities they find. One day Andrew Fountain, a glaciologist from Portland State University in Oregon, and went out with crampons and ice ax. He is study ing the way water gets to the Dry Valleys from glaciers, trying to tie that into the way the mate works here. Fountain had 90 stakes on sta glaciers in the valleys, measuring the ways ice ice grows and shrinks. He found that the mate patterns he hoped to understand difference subtly from glacier to glacier. The amount snow that fell on neighboring glaciers, in instance, may have been significantly affecting just by a little hill in the middle of the valles

"What started out to be a very simple problem," he said, "turns out not to be. The white thing is a matter of nuance."

Sometimes the nuances of scene and time were so immense they were staggering. Once, when I was hiking with Jamie Pierce, a mountaineer with experience on all seven continents, he stopped, looked around, and gave up trying to take it all in. "My mind's on overload," he said. "This is, like, nuts."

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Above us was a steep tumble of ice where the ice sheet of the Antarctic interior falls across the ridges and drops a blue puddle called the Wright Upper Glacier into the edge of the Dry Valleys. The falls are called Airdevronsix Icefalls after the Navy squadron that has worked in Antarctica since 1956.

This was a Niagara of ice, but much bigger. It was over three miles wide and more than 500 feet high. Huge chunks of ice cascaded down the falls; it looked as if New York City had been turned into salt blocks and shoved into the Grand Canyon. But the thing that really got me was that no matter how long I looked at it, nothing moved.

I watched and watched. The blocks were impossibly tilted, the angle impossibly steep. Things should be tumbling, crashing, thundering. But nothing moved. Time was roaring along out there, but we couldn't hear it.

into his headset's mike as a National Science Foundation helicopter clattered up a valley tiled with polygons created in loose rock by the flexing of frost. "Five degrees left! There! That's all Pleistocene there. Ten left!"

Marchant is a geologist from Boston University. He's a time detective. Marchant's current specialty is using volcanic ash to study the age of landscapes. Since ash can be dated more accurately than most other ancient materials because of the way isotopes in it mark the time passed since it was formed, any ash found where it fall is

where it fell is a tag marking the flow of time.

Marchant's tags have become critical lately because of a new theory that the deep sheet of ice that covers East Antarctica melted away as recently as three million years ago. This may leys context it's just a couple of moments past. This idea would mean that Antarctica's entire theories would have it

The bottom line is this: If the Antarctic ice sheet, which holds as much as 70 percent of the

world's fresh water, is that prone to melt, then global warming could raise sea levels by feet instead of inches, inundating coastlines around the world.

Marchant and others do not agree with this theory. Because the ash has been where it landed for far more than three million years, he thinks the Dry Valleys—and the adjacent ice sheet—have been much as they are for a lot longer than the melt theory would allow.

One morning when a blizzard kept us in camp, Marchant read me a short poem he wrote years ago:

By the questions we pose
Ourselves we deceive
So limited in thought
By what we choose to perceive.

Marchant laughed at the poem but wanted me to take it seriously. Its edge—a warning about blind spots in science—is his reaction to the debate about melting.

Later he and I sat on a rock in a valley of polished desert stones, and he talked about how rocks here are shaped by the brush of wind and the slow interaction of moisture and chemicals.

"A drop of water forms on the rock," he said.
"Every drop carries dissolved salt from the sea.
The drop slides under the rock and falls off.
Thousands of years later, and there's a grain of salt. Any stone probably has millions of years of salt under it."

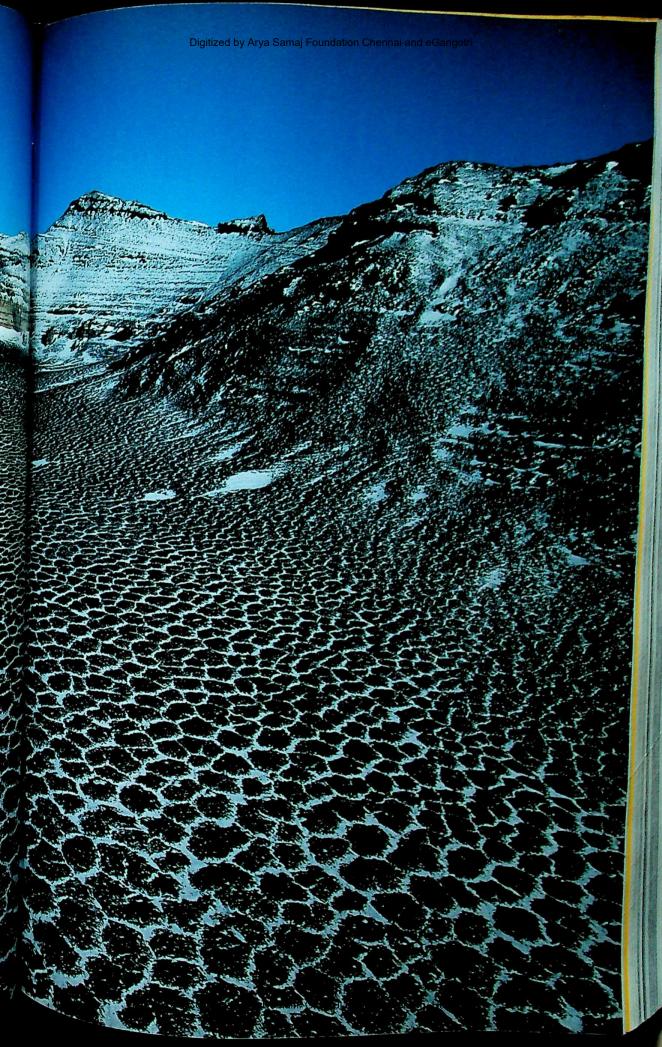
I picked up a flat stone. Under it was a little heap of salt. I felt as if I had disturbed the sleep of something. I put the rock back.

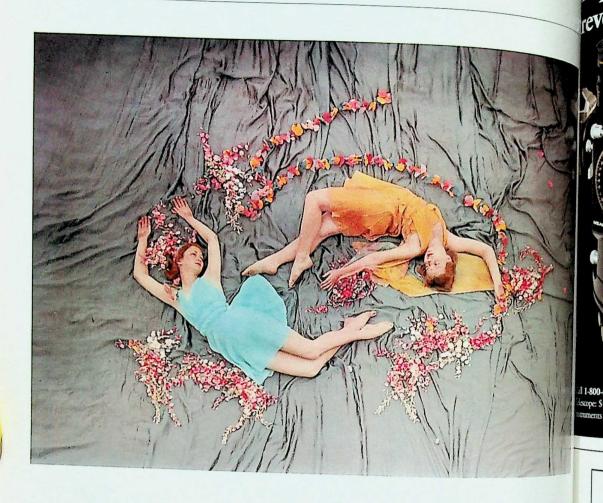
That salt was eerie. It reminded me of the dead seals and of the skull-shaped rocks behind Bruce Marsh's camp. This whole place is like an ancient skull, I thought, once a piece of the vibrant life of the Earth, now abandoned by the warmth and wetness that keeps the rest of the planet teeming with life. This skull is dried out and left to bleach, but we can pick it up off the ground where it's been lying for ten million years, stare like Hamlet into its strangely expressive shadow eyes, and know that there are many things hidden in time that we have yet to learn.

Marchant grinned at my amazement. He'd seen the Dry Valleys do this to others too.

"First you think there's nothing here, don't you?" he said. "Then there is too much."







■ FROM THE GEOGRAPHIC ARCHIVES

Still Magnolias

Artfully arranged by their dance teacher as a "living mural," these students spent hours posing on a theater curtain spread across the lawn of Mississippi State College for Women, in Columbus. Photographer J. Baylor Roberts leaned off a dormitory roof to shoot them for his "Magnolia State Mosaic," a portfolio of color plates published in September 1937.

Their silk dresses were strictly dance-department issue. "We were sheltered girls," recalls Dale Baker Doherty, at left. "Ordinarily we wore solid navy blue uniforms on campus," she says, "though sophomore year you could have a little white embroidery on your collar."

"We were allowed to put on makeup and perfume," says Jane Bullock Carson, at right, "just not much."

Doherty and Carson, both now 80, remember the photographer as a perfect gentleman. "Although I have to say," adds Doherty, "I thought it was pretty silly to have us lying on the ground like that."



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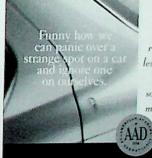
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■ EXPLORER, OCT. 11 **Predators Purr Excellence**

It's 8 p.m. Do you know where your kitty is? Even pampered, wellfed cats like Rush (right), who every evening enjoys dinner at the table with his doting owners-complete with candles, crystal, and china-have wildness coursing in their veins.

EXPLORER takes a look at The Secret Life of Cats and finds that Felix has dethroned Fido as the most popular pet in the United States and much of

Europe. In 20 years the number of house cats in the U.S. has doubled, and within each of these beloved companions beats the heart of a hunter.

"Ironically," the film notes, "the cat's ticket to domestication lay in its very wildness-its remarkable ability to hunt." This was once a boon for controlling rats aboard sailing ships, but with more than a hundred million cats now prowling the U.S., what are the consequences for birds and small mammals?

Ting Tang II, a Siamese, lives on a farm in southern Virginia with his owner, ornithologist



PAVEL GERMAN, NATURE FOCUS (TOP CENTER); TRIA THALMAN

Ruth Beck, who loves both her cat and birds. When she found that Ting was presenting her with about a bird a morning, Beck put her nighttime marauder on a strict curfew. "Our pets," Beck says, "are also predators."

Finding the right balance between cats and wildlife sometimes makes people go at it tooth and claw. Nowhere is the debate more intense than in Australia, where cats have colonized the entire continent, putting many native animals at risk. Millions of feral cats roam the country, and they don't read the endangered species list before they

pounce. This cat on the hunt (top center) brings down an endangered bridled nailtail wallaby.

Britain's Mammal Society conducted a survey titled "Look What the Cat Brought In," and The Secret Life of Cats features Missya Dorset puss revealed the survey to be one of the U.K.'s most prolifi: hunters of birds, mice. voles, and rabbits.

Many humans love their stealthy and offen haughty felines-from aristocats like the tortoiseshell Persian Marcus M'Donna (top let Best in Show at the

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Crab and Mallet Cat Club Show in Baltimore, Maryland, to a tumbling litter of barn kittens (top right). Cats, though, have their own notions about affection and what they take to be their just desserts.

■ PROGRAM GUIDE

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There are some people who should not take CLARITIN-D* 24 HOUR. You should not use this product if you have a bit of any medical are a history of difficulty in swallowing tablets or any medical problems associated with swallowing abnormalities. Other people need to be designed by the swallowing abnormalities. cople need to be especially careful using it. Therefore, be sure tell your healthcare provider if you have high blood pressure, or disease dial. hart disease, diabetes, glaucoma, thyroid or liver problems, or disculty urinating, or if a second, the MAO inhibitors frescription was or if you are taking MAO inhibitors prescription medicines that treat depression), or if you become pregnant or are nursing a baby. Also, CLARITIN-D* 24 HOUR host not be chewed or broken.

CLARITIN-D° 24 HOUR contains pseudoephedrine sulfate, which IN-D* 24 HOUR contains pseudoephedrine suitate, medications in many over-the-counter (OTC) and prescription netrousness classifications. Too much pseudoephedrine sulfate can cause and other related side cryousness, sleeplessness, dizziness, and other related side effects. Therefore, you shouldn't use both CLARITIN-D* 24 HOUR and OTC antibia. and OTC antihistamines and decongestants at the same time. CLARITIN-D³ 24 HOUR is available by prescription only. Schering / (E)/ Copyright © 1998, Schering Corporation, Rendworth, N. 07033. All rights control of Dublic Domain. Lets you be alert during the day and sleep at night. In studies, the incidence of drowsiness was 6% vs sugar pill, 4%; the incidence of sleeplessness was 5% vs sugar pill, 1%. Dry mouth was the most commonly reported side effect with CLARITIN-D* 24 HOUR (8% vs sugar pill, 2%

For a \$5.00 rebate certificate and important free information about relief of nasal congestion and other seasonal nasal allergy symptoms,

Call toll free 1-888-833-0003

Once-a-day

Claritin-D' 24 Hour

(10 mg loratadine/240 mg pseudoephedrine sulfate, USP) Extended Release Tablets

e see next page for additional important information.

www.claritin.com

CLARITIN-D® 24 HOUR

brand of loratadine and pseudoephedrine sulfate, USP **Extended Release Tablets**

BRIEF SUMMARY

(for full Prescribing Information, see package insert.)

INDICATIONS AND USAGE: CLARITIN-D 24 HOUR Extended Release Tablets are indicated for the relief of symptoms of seasonal allergic rhinitis. CLARITIN-D 24 HOUR Extended Release Tablets should be administered when both the antihistaminic properties of CLARITIN® (loratadine) and the nasal decongestant activity of pseudoephedrine sulfate are desired (see CLINICAL PHARMACOLOGY section).

CONTRAINDICATIONS: CLARITIN-D 24 HOUR Extended Release Tablets are contraindicated in patients

CONTRAINDICATIONS: CLARITIN-D 24 HOUR Extended Release Tablets are contraindicated in patients who are hypersensitive to this medication or to any of its ingredients. This product, due to its pseudoephedrine component, is contraindicated in patients with narrow-angle glaucoma or urinary retention, and in patients receiving monoamine oxidase (MAO) inhibitor therapy or within fourteen (14) days of stopping such treatment. (See PRECAUTIONS: Drug Interactions section.) It is also contraindicated in patients with severe hypertension, severe coronary artery disease, and in those who have shown hypersensitivity or idiosyncrasy to its components, to adrenergic agents, or to other drugs of similar chemical structures. Manifestations of patient idiosyncrasy to adrenergic agents or to other drugs of dizziness, weakness, tremor, or arrhythmias.

MARNINGS: CLARITIN-D 24 HOUR Extended Release Tablets should be used with caution in patients with hypertension, diabetes mellitus, ischemic heart disease, increased intraocular pressure, hyperthyroidism, renal impairment, or prostatic hypertrophy. Central nervous system stimulation with convulsions or cardio-vascular collapse with accompanying hypotension may be produced by sympathomimetic amines.

Use in Patients Approximately 60 Years of Age and Older: The safety and efficacy of CLARITIN-D 24 HOUR Extended Release Tablets in patients greater than 60 years old have not been investigated in placebo-controlled clinical trials. The elderly are more likely to have adverse reactions to sympathomimetic amines.

PRECAUTIONS: General: Because the doses of this fixed combination product cannot be individually litrated and hepatic insufficiency results in a reduced clearance of loratadine to a much greater extent than pseudoephedrine, CLARITIN-D 24 HOUR Extended Release Tablets should generally be avoided in patients with hepatic insufficiency. Patients with renal insufficiency (GFR <30 mL/min) should be given a lower initial dose (one tablet every other day) because they have reduced clearance of loratadine and pseudoephedrine.

dose (one tablet every other day) because they have reduced clearance of lonatadine and pseudoephedrine.

Information for Patients: Patients taking CLARITIN-D 24 HOUR Extended Release Tablets should receive the following information: CLARITIN-D 24 HOUR Extended Release Tablets are prescribed for the relief of symptoms of seasonal allergic rhinitis. Patients should be instructed to take CLARITIN-D 24 HOUR Extended Release Tablets are prescribed and not to exceed the prescribed dose. Patients should also be advised against the concurrent use of CLARITIN-D 24 HOUR Extended Release Tablets with over-the-counter antihist-amines and decongestants. Patients who have a history of difficulty in swallowing tablets or who have known upper gastrointestinal narrowing or abnormal esophageal peristalss should not use this product. This product should not be used by patients who are hypersensitive to it or to any of its ingredients. Due to its pseudoephedrine component, this product should not be used by patients with narrow-angle glaucoma, urinary retention, or by patients receiving a monoamine oxidase (MAO) inhibitor or within 14 days of stopping use of an MAO inhibitor. It also should not be used by patients with severe hypertension or severe coronary artery disease.

Patients who are or may become pregnant should be told that this product should be used in pregnancy or during lactation only if the potential benefit justifies the potential risk to the fetus or nursing infant.

Patients should be instructed not to break or chew the tablet and to take it with a glass of water.

Drug Interactions: No specific interaction studies have been conducted with CLARITIN-D 24 HOUR

Patients should be instructed not to break or chew the tablet and to take it with a glass of water.

Drug Interactions: No specific interaction studies have been conducted with CLARITIN-D 24 HOUR Extended Release Tablets. However, loratadine (10 mg once daily) has been safely coadministered with therapeutic doses of erythromycin, cimetidine, and ketoconazole in controlled clinical pharmacology studies. Although increased plasma concentrations (AUC 0-24 hrs) of loratadine and/or descarboethoxyloratadine were observed following coadministration of loratadine with each of these drugs in normal volunteers (n = 24 in each study), there were no clinically relevant changes in the safety profile of loratadine, as assessed by inflicant effects on OT, intervals, and no reports of seafation or syncope. No effects on plasma concentrations of cimetidine or ketoconazole were observed. Plasma concentrations (AUC 0-24 hrs) of erythromycin decreased 15% with coadministration of loratadine relative to that observed with erythromycin alone. The clinical relevance of this difference is unknown. These above findings are summarized in the following table:

Effects on Plasma Concentrations (AUC 0-24 hrs) of Loratadine and Descarboethoxyloratadine After

10 Days of Coadministration (Loratadine 10 mg) in Normal Volunteers

Loratadine

Descarboethoxyloratadine

	The state of the s	
Erythromycin (500 mg Q8h) Cimetidine (300 mg QID) Ketoconazole (200 mg Q12h)	Loratadine + 40% +103% +307%	Descarboethoxyloratadine +46% + 6%

There does not appear to be an increase in adverse events in subjects who received oral contraceptives and

There does not appear to be an increase in adverse events in subjects who received oral contraceptives and loratadine.
CLARITIN-D 24 HOUR Extended Release Tablets (pseudoephedrine component) are contraindicated in patients taking monoamine oxidase inhibitors and for 2 weeks after stopping use of an MAO inhibitor. The antihypertensive effects of beta-adrenergic blocking agents, methyldopa, mecamylamine, reserpine, and vera-trum alkaloids may be reduced by sympathomimetics. Increased ectopic pacemaker activity can occur when pseudoephedrine is used concomitantly with digitalis.

Drug/Laboratory Test Interactions: The *in vitro* addition of pseudoephedrine to sera containing the cardiac isoenzyme MB of serum creatinine phosphokinase progressively inhibits the activity of the enzyme. The inhibit

isoenzyme MB of serum creatinine phosphokinase progressively inhibits the activity of the enzyme. The inhibition becomes complete over 6 hours.

Carcinogenesis, Mutagenesis, Impairment of Fertility: There are no animal or laboratory studies on the combination product loratadine and pseudoephedrine sulfate to evaluate carcinogenesis, mutagenesis, or In an 18-month carcinogenicity study in mice and a 2-year study in rats loratadine was administered in the assessments were carried out to determine animal exposure to the drug. AUC data demonstrated that the exposure of mice given 40 mg/kg of loratadine was 3.6 (loratadine) and 18 (active metabolity limes higher loratadine was 28 (loratadine) and 67 (active metabolity lorations) higher than in humans given the maximum recommended daily oral dose. Exposure of rats given 25 mg/kg of recommended daily oral dose. Male mice given 40 mg/kg had a significantly higher incidence of hepatorincidence of hepatocellular tumors (combined adenomas in han concurrent controls. In rats, a significantly higher mg/kg and in males and temales given 25 mg/kg. The clinical significance of these findings during long-term use of loratadine is not known.

Two-year feeding studies in mice and rats conducted under the auspices of the National Toxicology 27 mg/kg, respectively (approximately 16% and 100% of the maximum recommended human daily rat doses up to 10 and of pseudoephedrine sulfate on a mg/m basis; In mutagenicity studies with loratadine alone, there was no evidence of mutagenic potential in reverse (Ames) or forward point mutation (CHO-HGPRT) assays, or in the assay for DNA damage (Rat Primary Hepatocyte Unscheduled DNA Assay) or in two assays for chromosomal aberrations (Human Peripheral Blood Lymphocyte Clastogenesis Assay and the Mouse Bone Marrow Erythrocyte Micronucleus Assay) in the Mouse Lymphoma Assay, a positive finding occurred in the nonactivated but not the activated phase of the study.

The Mouse Cympholia Assay, a positive limiting deceased in the honactivated but not the activated phase of the study.

Decreased fertility in male rats, shown by lower female conception rates, occurred at 64 mg/kg of lorata-dine (approximately 50 times the maximum recommended human daily oral dose based on mg/m²) and was reversible with cessation of dosing. Loratadine had no effect on male or female fertility or reproduction in the rat at 24 mg/kg (approximately 20 times the maximum recommended human daily oral dose on a mg/m² basis).

Pregnancy Category B: The combination product foratadine and pseudoephedrine sulfate was evaluated for teratogenicity in rats and rabbits. There was no evidence of teratogenicity in reproduction studies with this combination of the same clinical ratio (1:24) at oral doses up to 150 mg/kg (approximately 5 times the CC-0. In Public Domain. Gurukul Kangri Collection, Hariawan Corporation, Kenilworth, NJ 07033 USA Al Copyright Copyright

maximum recommended human daily oral dose on a mg/m² basis) in rats and 120 mum recommended human daily oral dose on a mg/m² basis) in rats and 120 mum recommended human daily oral dose on a mg/m² basis) in rats and 120 mum responsitive in rats and 120 mum responsitive in rats and 120 mum responsitive in rats and 150 times, respectively, the maximum human daily oral dose on a mg/m² or oral dose oral dos

ning pregnancy only if clearly needed.

Nursing Mothers: It is not known if this combination product is excreted in him of the when administered alone and its metabolite descarboethory/oratable pass achieve concentrations that are equivalent to plasma levels, with an ALIC_MIL. The parent and active metabolite, respectively. Following single oral dose at 40 in the parent and active metabolite was excreted into the breast mik (approximate) 0.0% of the parent and active metabolite was excreted into the breast mik (approximate) 0.0% of the parent pass and the parent pass and the parent pass and the parent pass are consistently higher than those in plasma and the pass and the pass and the pass are consistently higher than those in plasma and the pass and the pass are consistently higher than those in plasma and the pass are consistently higher than those in plasma and the pass are consistently higher than those in plasma and the pass are consistently higher than those in plasma and the pass are consistently higher than those in plasma and the pass are consistently higher than those in plasma and the pass are consistently higher than those in plasma and the pass are consistently higher than those in plasma are consistently higher than the consistent with the plasma are consistently higher than the consistent with the plasma are consistently higher than the consistent with the consistent with the plasma are consistently higher than the consistent with th

to a nursing woman.

Pediatric Use: Safety and effectiveness in children below the age of 12 years have not become ADVERSE REACTIONS: Information on adverse reactions is provided from peaces involving over 2000 patients, 605 of whom received CLARTIN-D 24 HOUR Exercises that the control of the peace of

IODEPHEDITINE ADVERSE EVENTS WITH AN INCIDENCE OF ≥2% IN CLARITING (24/0);
RELEASE TABLETS TREATMENT GROUP IN DOUBLE-BLIND RANCKIZ
PLACEBO-CONTROLLED CLINICAL TRIALS

PERCENT OF PATIENTS REPORTING

	CLARITIN-D® 24 HOUR (n ≈ 605)	Loratadine 10 mg (n = 449)	Pseudoephedrig 120 mg q12h
Dry Mouth	8	2	(n = 220)
Somnolence	6	4	7
Insomnia	5	7	5
Pharyngitis	5	5	9
Dizziness	4	3	5
Coughing	3	2	3
Fatigue	3	4	3
Nausea	3	2	
Nervousness	3	1	1
Anorexia	ž	<1	4
Dysmenorrhea	2	2	2
A CONTRACTOR OF THE CONTRACTOR	The second secon	-	4

Dysmenorrhea

Adverse events occurring in greater than or equal to 2% of CLARITIN-02 HDR from Tablets-treated patients, but that were more common in the placebo-treated group rouse. Adverse events did not appear to significantly differ based on age, sex, or raz around in addition to those adverse events reported above, the following adverse events in addition to those adverse events reported above, the following adverse events fewer than 2% of patients who received CLARITIN-0.24 HOUR Extended Relazer labor. Autonomic Merouss System: Altered lacrimation, flushing, increased swaring protest about As A Whole: Abnormal vision, astherial, back pain, chest pain, conjuding solicital edema, fever, flu-like symptoms, leg cramps, lymphadenopathy, makes non-time solicitation, activicardia. Central and Peripheral Nervous System: Convulsions, dysphonia, hypercess sparesthesia, tremor.

paresthesia, tremor

Central and Peripheral Nervous System: Convusions, dysphonia, hypericess here paresthesia, tremor.

Gastrointestinal System: Abdominal distension, altered taste, constipation, dealered, assisting the constipation of the constitution of the consti

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sophageal peristalisis.

OVERDOSAGE: In the event of overdosage, general symptomatic and supports except tuted promptly and maintained for as long as necessary. Treatment of overdosage of emesis (operacing symptomatic and supports and supp

Schering.

Farth Almanac

Are Hungry Mongoose Babysitters Rewarded?

Small mongooses called suricates, or meerkats, band together in groups of 3 to 25 animals for mutual survival in southern Africa's Kalahari Desert. They seem to have rules for everything, such as which members can breed and which can't. Suricates that don't breed often serve as babysitters for the successful breeders' pups. While the parents go hunting for insects and small vertebrates, the babysitters guard the little ones from birds of prey and jackals.

Since these helpers can't forage, they lose a lot of weight, according to biologist Tim Clutton-Brock and his colleagues at the Universities of Cambridge and Pretoria. They seek to unravel an evolutionary mystery: Since the babysitters pay such a great price, do they receive hidden benefits for their altruism from the rest of suricate society?



Endangered Species Rally

A helping hand from conservationists can make a difference for imperiled animals and plants. Last May the U.S. Fish and Wildlife Service announced that 30

Species had recovered enough that, over the next two years, it plans to downgrade them from endangered to all gered to threatened or remove them from the list altogether. The good news affects the gray wolf, bald eagle, peregrine falcon, and "a tough little plant, called Robbins' cinquefoil (above), says one of its champions, Ken Kimball, botanist and





director of research for the Appalachian Mountain Club. Mainly found on a 1.5-acre site in New Hampshire's White Mountains, the plant was declared endangered in 1980. Two local hiking trails were then relocated. The New England Wild Flower Society propagates the plants in a nursery, and they are then transplanted to nearby sites (above).



G. RYAN, GREAT BARRIER REEF MARINE PARKAUS

Refuges for Australia's Dugongs

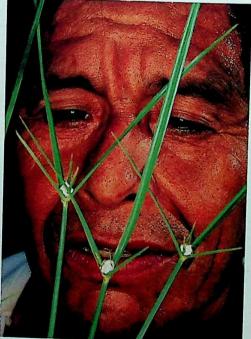
Saltwater cousins of manatees, at least 85,000 dugongs swim off Australia, including this one near the Great Barrier Reef. But dugongs on the reef's southern end are in trouble, reduced from some 3,600 to about 1,600 since 1987. The animals drown in commercial gill nets and antishark nets and coastline development has destroyed sea grass beds they feed on.

Dugong protection has been beefed up, with 15 new sanctuaries totaling 1,795 square miles established along the southern reef. In them gillnetting has been restricted or banned.

Hunting Prowess From Plants

Secret weapons from nature enhance the bows and arrows of the Matsigenka (Machiguenga) people living in Peru's Manu National Park, To focus their aim and improve their concentration, men cultivate varieties of sedges like this one as hunting medicines, which they call ivenkiki. White growths are a fungus that kills the sedges' fruits and flowers but not the bulb—crucial to the hunters. The fungus infuses the bulb with an alkaloid that when chewed acts as a physical and mental stimulant.

Men use different sedges when hunting different prey-spider monkeys, woolly monkeys, tapirs, or fish. Although the chewed root is not poisonous, men may also rub it



on their arrows, believing it improves their shots.

Anthropologist Glenn Shepard, Jr., who has studied the Matsigenka for 12 years, once gained a temporary talent from a sedge To amuse villagers, he had long tried to juggle fruit but couldn't learn the trick When the sedge stimulant took effect, "It improved my concentration in some subtle way, and suddenly I realized, Wow, I'm juggling!" Shepard says.

Men also use sedge liquid as eyedrops to improve their vision. The give other plants to their dogs to sharpen tracking skills. Matsigenka women have their own apotheral of about 50 species of

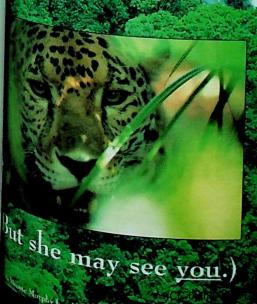
of about 50 species of about 50 species of all plants used in caring for newborn infants. In all Matsigents are a laborated to the control of Matsigenka use more than 270 medicinal plants TEXT BY JOHN L. ELIO



Don't Be Afraid

You'll never see a jaguar in the Honduran jungle.

The jaguar - Latin America's most formidable predator - is a scaredy cat. Fearful of humans, this shy creature almost never reveals itself in the wild. Yet we find its tracks in many of our national parks; we know it thrives in Honduras. Each of these hig cats requires a huge territory to survive; so much undisturbed forest, in fact, that the very presence of jaguars indicates a healthy ecosystem. For if our wetlands, rain forests and cloud forests are extensive and intact enough to support large predators, they can easily accommodate 700 kinds of birds and the thousands of other species that inhabit the jaguar's domain plants and animals that you will see, hear, smell, and touch as you get to know our diverse wildlands.



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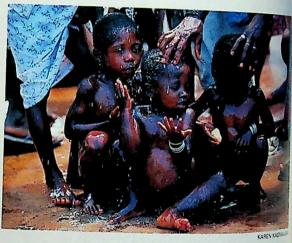
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■ ONLINE

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As the next millennium beckons, the Society has harnessed a team of scholars to help create a statistical snapshot of the planet. Now we need your answers to a 20-minute online survey about human migration and its effects on identity. We'll ask how often you've moved, what music you like, what authors you know, what foods you eat. Be part of an unprece-



dented project at http://survey2000.nationalgeographic.com.

■ Today's children (above) face a world more crowded and complicated than ever before. View a selection of stunning images and ponder insights from the authors of this issue's millennium articles on population at www.national geographic.com/features/2000/population.

■ Imagine you're the writer who covered the 1923 opening of King Tut's tomb or preview the Geographic's first giant-screen film at . . . /features/98/egypt.

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■ CD-ROM

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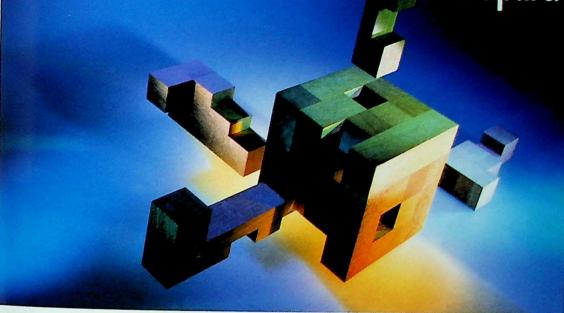
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Because it's all part of the earth.

It had never been done before. Take an ordinary office machine and turn it into a model of ecological manufacturing. Focus on eliminating waste and saving resources. The result is earth-friendly and economical. Kyocera's Ecosys printer.

First, we made it easy to disassemble and separate the parts. In the Ecosys, plastic and metal parts are not bonded together as in many other printers. We also took great care to eliminate pollutants. Ecosys parts are made of polymer some manufacturers use.

Next, we reexamined the cartridge system. A typical printer cartridge comprises toner, developer, drums, rollers and other components, many of which become waste.



So we designed a cartridge-free system. An ultra-durable amorphous silicon drum made it possible to incorporate most of the parts into the printer. When it's time for new toner, all that needs to be replaced is the toner container.

And our environmental concern doesn't stop with the printer. It carries right on through to the packaging: easy-to-recycle cardboard and recycled pulp mold. It costs us more, but we believe it's more earth-friendly than the widely used polystyrene.

Today, Kyocera's Ecosys printer bears the world's most important symbols of ecological responsibility.* You might say it's a model of environmental design. It wasn't easy to produce. But we think a healthy planet is worth the extra effort.

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OnAssignment



■ WOMEN AND POPULATION She's Connected

"They wanted to know as much about me as I did about them," says freelance photographer Karen Kasmauski (above, with camera) of the aspiring entrepreneurs she met in Dhaka, Bangladesh. The women had recently received bank loans to purchase cellular telephones, which fellow villagers pay

to use. Doing double duty for this issue—Karen also covered the human migration story—she visited nine countries over four months. Everywhere she went, she felt a kinship with the womes she photographed. "Even though our lives are very different, I'm a wife and mother too," she spoulation, of course, is not simply a women's issue. "It's everybody's issue," says Karen. "It take two people to start a family."



■ ANTARCTIC DESERT Song of the South Pole

No carols rang from the tents last Christma Eve at Cirque 6 in Antarctica. "We played Motown instead," recalls photographer Man Stenzel, at center, grooving with grad students. Beth Hartman and Sarah Mills. Next morned "we all got comic books as gifts, but then we had to give them back. They've reused the same comics for 12 years." Outdoor stories like this one are Maria's favorites to shoot. "I never wanted to camp much as a kid," says. "I guess I'm having my childhood now says. "I guess I'm having my childhood now."

NATIONAL GEOGRAPHIC (ISS COOR) 3451 PUBLIC: POMORITIC GUPUKUL KANGTI COllection, Haridwar \$27.00 A YEAR, \$5.00 A COPY. PERIODICALS POSTAGE PAID AT WASHINGTON, D.C., AND AT ADDITIONAL MAILING OFFICES. POSTMASTER: SEND ADDRESS CHANGES TO NATIONAL GEOGRAPHIC, P.O. BOX 63002, TAMPA, FLORIDA 33663-3002.

VOL. 194



NOVEMBER 1998

SEOGAPHIC CEOGAPHIC

MAUI'S MONSTER WAVES

AMERICA'S WILDERNESS 2
THE COSSACKS 34
RED COLOBUS MONKEYS 72
SHACKLETON EXPEDITION 82
ABUSIR TOMB 102
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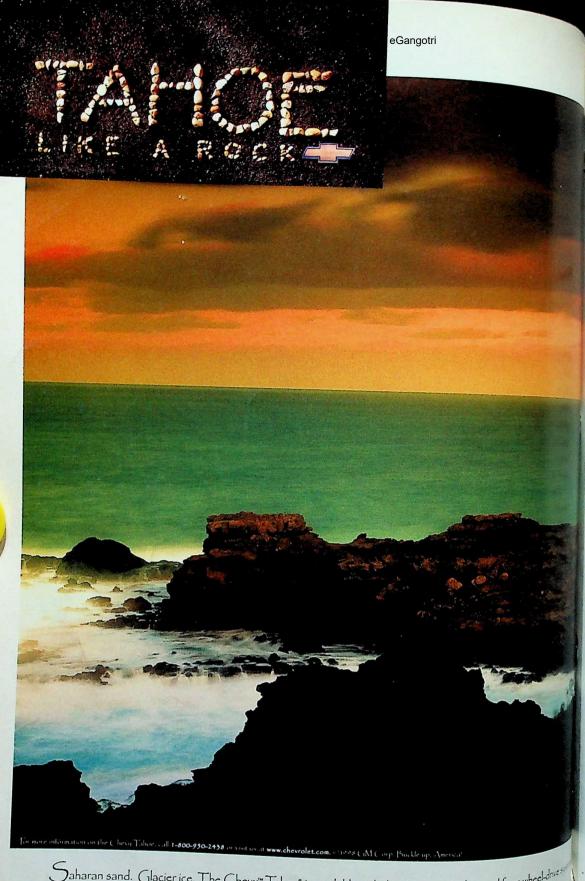
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NATIONAL GEOGRAPHIC

From the Editor

"why don't you CALL your magazine International Geographic?"

We get letters asking that question all the time, and while it's probably best that we stick with the name that has served us so well for 110 years, there's no question that the global scope of our readership is light-years beyond that of our first issue, when of 217 Society members only 31 lived outside the District of Columbia.

Today the English-language edition of NATIONAL GEOGRAPHIC is read in nearly every country. And to make the magazine we are so proud of accessible to even more people, we have begun publishing local-language editions as well.

Since its launch in 1995 the GEOGRAPHIC's Japanese-language edition has been followed by editions in Spain Letin American July 1995

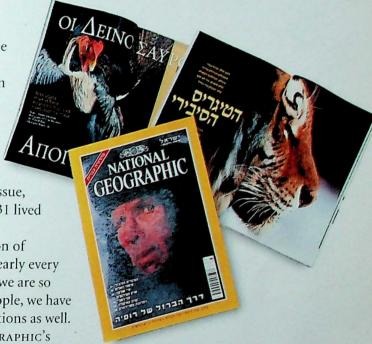
editions in Spain, Latin America, and Italy. Now two more local-language versions of the magazine are appearing, in Greece and Israel.

Greeks are already well acquainted with us through Greek-language National Geographic videos. In fact, Greeks began taking out Society memberships months ago in anticipation of the Greek edition's October launch.

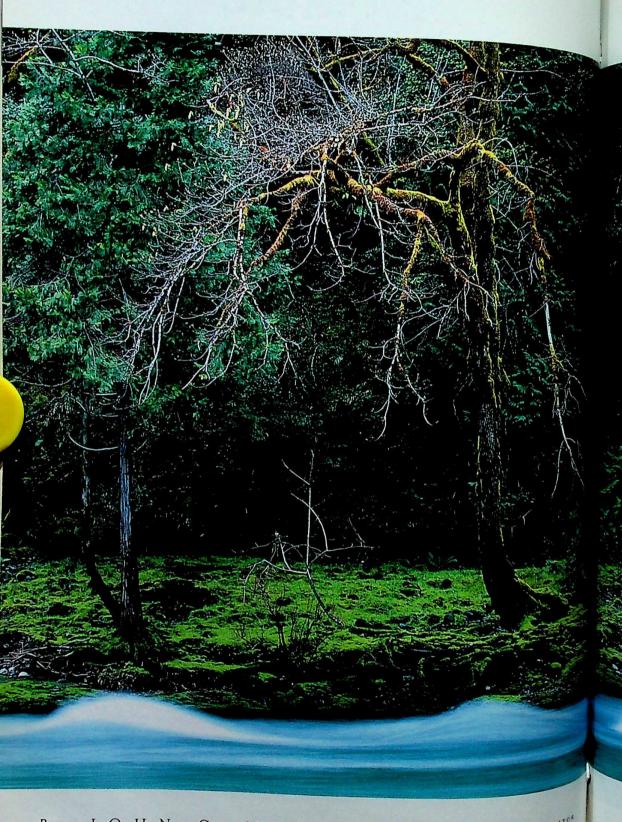
For Israelis, the June arrival of our Hebrew edition was perhaps a footnote in the month that marked their nation's 50th anniversary. Still, it was warmly embraced by readers. Our first pressrun of 25,000 copies sold out in less than a week, and more than 15,000 Israelis have joined the Society.

Translating a magazine into another language involves more than just pouring type onto a page. The Hebrew edition, for example, reads "backward," with the issue beginning on what Americans would consider the back page. Each two-page layout has to be reviewed by the Israeli staff, with final approval for any changes coming from our Washington, D.C., headquarters—as is so for changes in all our international editions.

As our family of international editions grows, it's exciting to think of people around the world, with vastly different cultures and languages, sharing this magazine every month. So what if it doesn't say *International Geographic* on the cover?



Bill allen



By JOHN G. MITCHELL SENIOR ASSISTA

Photographs by PETER ESSICK

Wilderness held little allure for early settlers. Deep and dark, full of beasts and demons, it was good for one thing: taming. But as America's vast blanket of wildlands was reduced to swatches, wilderness became a refuge—

ERNESS

for both wildlife and people.

In 1964 the United States began designating roadless areas as wilderness. These lands haven't necessarily escaped the hand of man, but they have been given the chance to survive it. Wolves and grizzlies no longer roam

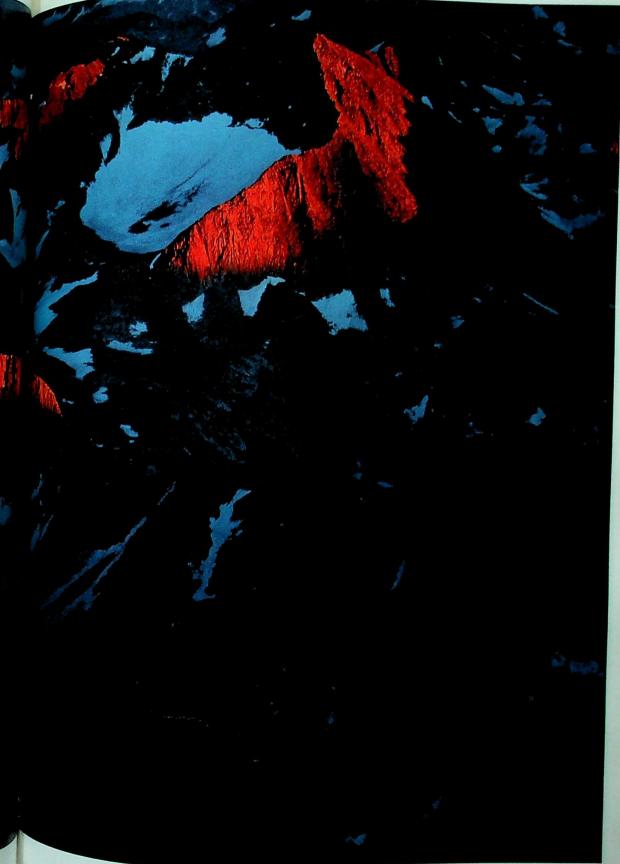
Oregon's Kalmiopsis Wilderness

(left), yet it remains one of the wildest and most botanically diverse areas in the lower 48.

America's Lands Apart



Thousands of tired, nerve-shaken, overcivilized people are beginning to find that go.



SEQUOIA-KINGS CANYON WILDERNESS, SEQUOIA AND KINGS CANYON NATIONAL PARK, CALIFORNIA

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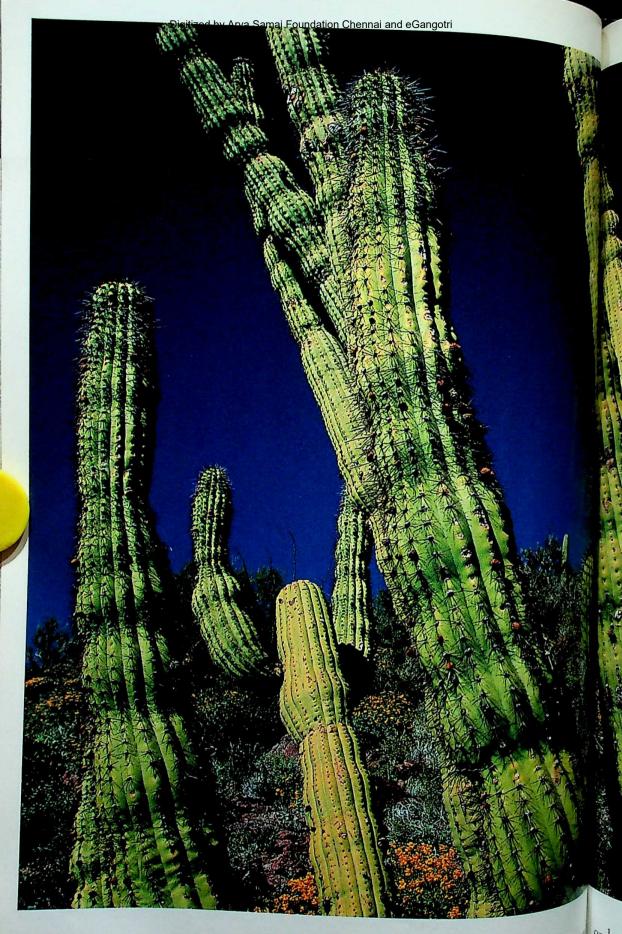
find going to the mountains is going home; that wilderness is a necessity. . . .

— JC

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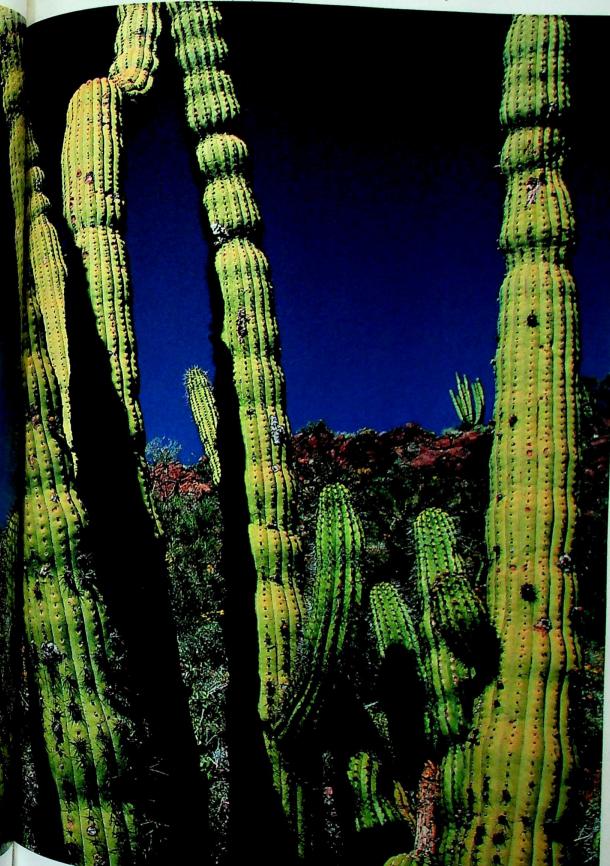
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-JOHN MUIR



You can't see anything from a car. . . . You've got to . . . walk, better yet on han

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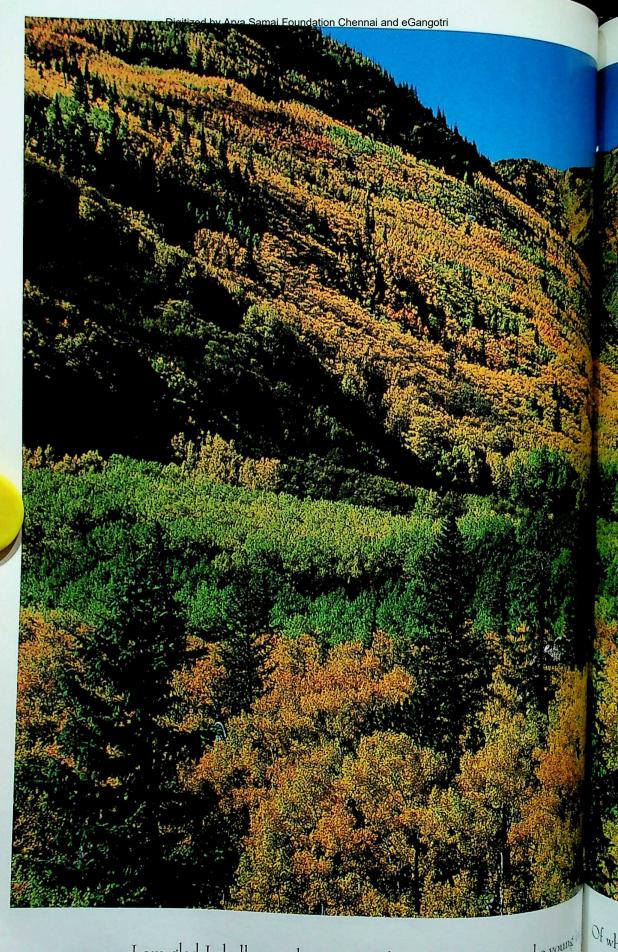


ORGAN PIPE CACTUS WILDERNESS, ORGAN PIPE CACTUS NATIONAL MONUMENT, ARIZONA

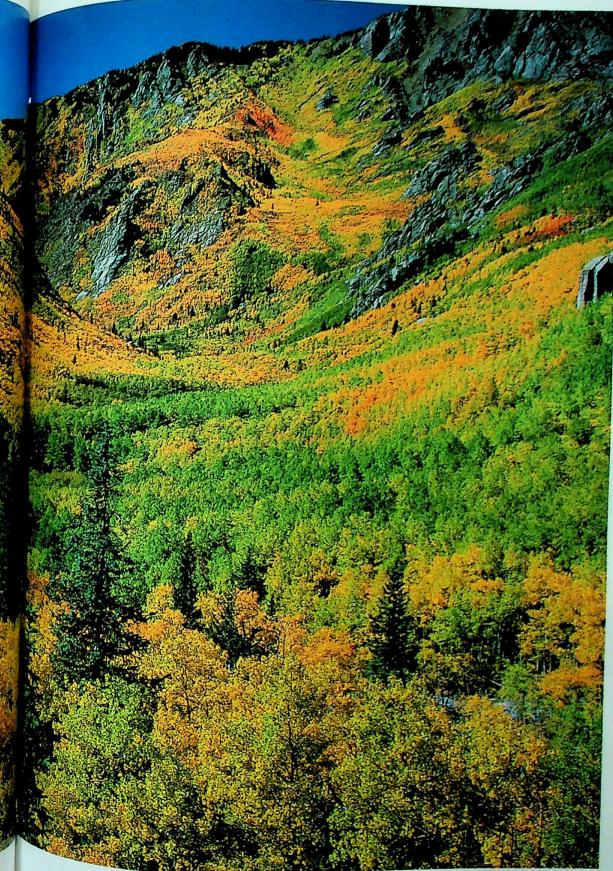
on hands and knees, over the sandstone and through the thornbush and cactus.

—EDWARD

-EDWARD ABBEY



I am glad I shall never be young without wild country to be young



Of what avail are forty freedoms without a blank spot on the map?



т is напо то resist a place that is known as Kootznoowoo, Fortress of the Bears. That's what the resident Tlingit call it, rejecting the squarerigged English name, Admiralty Island, and the antique fur trader's Russian, Ostrov Kutsnoi, Fear Island. One wonders which the fur men feared more—the Tlingit or the bears. Or the wilderness.

And wilderness it remains, most of this island in the rain forest archipelago of southeast Alaska—nearly a million acres of statutory uppercase-W Wilderness set aside by the U.S. Congress out of the country's largest national forest, the Tongass. There are 18 other designated wilderness areas in the Tongass and 624 throughout the federal lands of the United States. A lot to choose from. But because of my lack of resistance to bears, I have chosen Kootznoowoo to help me gather my thoughts about wilderness and share what I've seen and heard of it elsewhere over the years.

A floatplane has brought me to this pebbled beach at the edge of Windfall Harbor, a notch in Kootznoowoo northeast of the Tlingit village of Angoon. About 600 people live in that village. The island's bears are said to outnumber them two to one.

Coming in, we saw a couple of bears from the air, big brown grizzlies grazing on spawned-out salmon in the estuaries of Windfall's graveled streams. My companion, David Cline, an Anchorage conservationist and chairman of the nonprofit Kodiak Brown Bear Trust, instructed the pilot to put us down at a beach where there aren't any salmon streams. Though Cline had once been charged by a grizz and successfully outbluffed it, he assured me that coastal bruins prefer salmon to people almost every time. Almost? I wondered. And I forgot to bring pepper spray.

It is a fortress all right, this Kootznoowoo Wilderness. Beyond the beach the forest begins in a tangle of saltwater sedge and alder, then reaches for the sky in jagged battlements of Sitka spruce and western hemlock. Inland the forest floor yields a labyrinth of giant moss-covered snags and nettlesome clumps of devil's club. West, above the misted moat of Windfall Harbor, the mountains rise steeply through layered clouds to elevations of 4,000 feet. It is the kind of terrain that frowns on a casual stroll. The place for walking is the beach, at low tide. In the morning Cline and I will catch that tide and walk up the beach to the head of the harbor, looking for bears at a respectful distance.

So what thoughts do I have to gather, standing alone at the edge of the water while Cline scouts the fortress for a good place to camp? Only that one can never know enough about wilderness even if one has been scratching the territory and the idea for half a lifetime. And that is something to gather right off the bat, for wilderness is not just a place, or a congeries of places, or a management system—the National Wilderness Preservation System—that was put in place by an act of Congress. Wilderness is an idea. It is an idea at once personal and worldly—as personal as risk and freedom and solitude and

Although PETER ESSICK's photographic assignments have taken him around the world, Peering into the past and documenting diverse cultures, his most recent work delves into environmental issues in the United States.

spiritual refreshment, as worldly as the living earth and waters that define it.

More than a century and a half ago the Concord eccentric Henry David Thoreau begged in writing to be shown "a wildness whose glance no civilization can endure." If he ever came close to experiencing such a thing, it was likely near the top of Maine's Mount Katahdin in September 1846. He would write of feeling "the presence of a force not bound to be kind to man." It was a presence I had clearly felt myself, often in mountain country, once or twice in places where I imagined no other human might ever have stood. I had felt it too just moments ago, after our pilot waved good-bye, kicked on the engine of his plane, and taxied into the harbor for his takeoff toward Juneau.

"Talk of mysteries!" Thoreau had written of those other woods a wild continent away. "Think of our life in nature,—daily to be shown matter, to come in contact with it,—rocks, trees, wind on our cheeks! the solid earth! the actual world!" I watched the floatplane lift off the water into the clouds. Then even the sound of it was gone. "Contact!" Thoreau had written, and for a second I thought I might have said the word myself. "Contact!"

N SEPTEMBER 3, 1964, after eight years of deliberation and 66 drafts, an act creating the National Wilderness Preservation System passed under the pen of President Lyndon B. Johnson. The measure established 54 wilderness areas in national forests in 13 states and decreed that the 9.1 million acres within them were to be protected in their natural condition. Wilderness, the act declared, was to be recognized "as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." And the law further stipulated that such areas were to be forever free of "permanent improvements" such as roads and man-made structures.

Additional measures were later enacted to include more wildlands in the eastern U.S. and expand protection beyond national forests to selected backcountry areas of the National Park System, the National Wildlife Refuge System, and the public domain of the Bureau of Land Management. In 1980 the Alaska National Interest Lands Conservation Act more than doubled the system's existing acreage while allowing established practices, such as the use of motorboats and floatplanes, prohibited in most wilderness areas in the lower forty-eight. Today the nation's 624 wilderness areas embrace more than a hundred million acres, or about 4.5 percent of the U.S. landmass.

Even before a wilderness system was officially in place, exuberance and a fondness for mountain scenery posted me along the edges of a few of its future sites. I recall a scramble on the Great Western Divide of the Sierra Nevada above Mineral King, where the trail cairns made contact with a high, craggy country destined to become the Sequoia-Kings Canyon Wilderness. At 736,980 acres it is California's second largest, after the Death Valley Wilderness. And once there was a wind-chapped prowl on a spiny, porphyritic ridgetop in New Hampshire's White Mountains, above the green gulf of the once and future Pemigewasset Wilderness.

Since those early days, my sorties into this diverse assemblage of wildlands have ranged from a tundra hike in the most remote of them all, the Mollie Beattie Wilderness (eight million acres in the Arctic National Wildlife Refuge on Alaska's North Slope), to a binocular visit to one of the system's smallest units, Three Arch Rocks (a 15-acre seabird sanctuary off the Oregon coast and off-limits to humans). But I've missed so much of it too—the Delirium and the Menagerie, Apache Kid and Cache la Poudre, the Washakie, the Popo

The U.S. Wilderness System

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Though most Americans live within an easy day's drive of one of the nation's 624 wilderness areas, more than half the system's 104 million acres are in Alaska, and most of the rest are in western states. In the East, where barely a tree escaped the ax, requirements were adjusted in 1975 to allow wilderness designation for lands recovering from human use.

58,182,216 Alaska
 13,957,063 California
 4,529,061 Arizona
 4,324,182 Washington
 4,015,061 Idaho
 3,442,416 Montana
 3,253,945 Colorado
 3,111,132 Wyoming
 2,096,403 Oregon
 1,648,475 New Mexico

State with fewer than 1.5 million acres

States with no wilderness areas shown in gray

Agie, the Irish, the Scapegoat and the Superstition, Bisti, Bear Wallow, Blood Mountain, and Hell Hole Bay, among many others.

Still, I have seen and heard enough, in the places that I didn't miss, to report that the National Wilderness Preservation System is holding up reasonably well after nearly 35 years. Not that its stewards are wanting for problems. Like the national forests, parks, and refuges that contain it, Wilderness U.S.A. is peppered with problems of heavy use, abuse, and underfunding, eroded trails, invasive species, squabbling constituencies, and local interests hostile to government regulation. Yet so far, for the most part, the resource prevails.

Of all the problems, visitor impact on trails and campsites consumes the largest segment of the backcountry managers' time and charges. Almost everyone in the U.S. today lives within an easy day's drive of a wilderness area, and each year more people are making the trip. Though absolute numbers are hard to come by, the agencies report that recreational use of wilderness has increased sevenfold over the past three decades. The most heavily used areas remain those closest to large metropolitan areas, such as Denver, Los Angeles, and Seattle. Near Seattle the Alpine Lakes and Mount Baker Wilderness Areas are about as hard hit by hikers and backpackers—and erosive rainstorms—as

any in the system. "Just trying to keep these mountain trails open is a major challenge," says Gary Paull of the Forest Service. "And it doesn't help to be operating with a trails budget two-thirds of what it was three years ago."

Such problems seem remote here at the misty edge of Kootznoowoo, where there are no visitors but us and no greater immediate challenge than the prospect of starting a cook fire with wet wood.

T IS DONE. From hemlock shavings come wisps of white smoke, a puff of orange, glowing, growing, curling around the kindling. Done. David Cline is a good scout.

Sitting now with our boots to the woodsmoke, Cline and I agree that while those little gas-fed backpacker stoves may be ecologically correct—if not obligatory in wood-scarce or combustible backcountry—they cannot begin to match the crackling ambience of a good old-fashioned campfire. What is it that bonds us so tightly to woodsmoke and pyrolysis? The spark of some primordial memory, the gene that reminds us how dreadful it must have been when the dark was never light enough at the back of the cave? Cline isn't sure, and neither am I.

Nor can we be sure of absolute answers when the fireside chat turns to contemporary questions, such as the pros and cons of manipulating wilderness in order to preserve or restore some degree of primeval naturalness. Fire sits at the center of that issue too, not our tidy Kootznoowoo campfire but rather the big burns ignited by nature's lightning and the smaller burns prescribed by human managers to compensate for decades of fire suppression.*

In a few wilderness areas natural wildfires are no longer suppressed where they pose no threat of serious smoke pollution or damage to neighboring properties. But in many regions natural fires may not occur often enough to restore wild land to what some scientist thinks might have been its pristine, pre-Smokey Bear condition. In which case the managers may intervene by orchestrating a prescribed burn.

"In designated wilderness," Cline says, "I'd have a problem with that, just as I would with suppression of fire"

So would a lot of other people. I tell Cline of my visit to a wilderness conference at the University of Montana in Missoula a few months earlier and of the dichotomy there between defenders of intervention management and those who believe wilderness is managed best when it is managed least or not at all. "We can't just let these areas 'go,' or we'll end up with something we never anticipated," said one scientist who advocates intervention. But on the other side of the issue, Tom Power, a writer and economics professor at the University of Montana, told me: "The wilderness agencies have no humility, just this sweeping idea that landscape managers can do better than nature can."

More troublesome than fire for some managers is the prospect of exotic species invading wilderness to usurp native habitats. In Montana years ago horses or cows introduced the seeds of two unwelcome plants, leafy spurge and spotted knapweed. The exotics have since spread over hundreds of thousands of acres, transforming wilderness grasslands into weedy barrens.

Meanwhile, in dozens of wilderness areas across the country, lakes and streams were stocked with non-native fish to enhance the visitor's recreational opportunities. But all too often there was an unexpected catch: The alien species ate up or starved out the indigenous ones and altered the ecosystem.

^{*}See "The Essential Element of Fire," by Michael Parfit, in the September 1996 issue.

So what's the solution? Do managers, as some would argue, refrain from further meddling and hope that nature will set things right in the long run? Or, for the sake of restoring a lost naturalness, do they intervene—sometimes with chemicals—to purge the spurge and the alien trout?

Cline, who once served a hitch as a wilderness biologist with the U.S. Fish and Wildlife Service here in Alaska, is squinting at me through the woodsmoke. We agree there is no easy answer. What might succeed on a wilderness island off the coast of Alaska might not work at all off the coast of Georgia.

UMBERLAND ISLAND is the southernmost of Georgia's barrier islands and its largest, with 17 miles of white-sand beach and a maritime forest of moss-draped live oaks and towering loblolly pines. It



DECADES OF FIRE SUPPRESSION HAVE TURNED MANY FORESTS INTO TINDERBOXES. CONTROLLED BURNS—LIKE THIS ONE IN SEQUOIA-KINGS CANYON WILDERNESS—ARE INCREASINGLY USED TO PREVENT INFERNOS AND RESTORE NATURAL CONDITIONS.

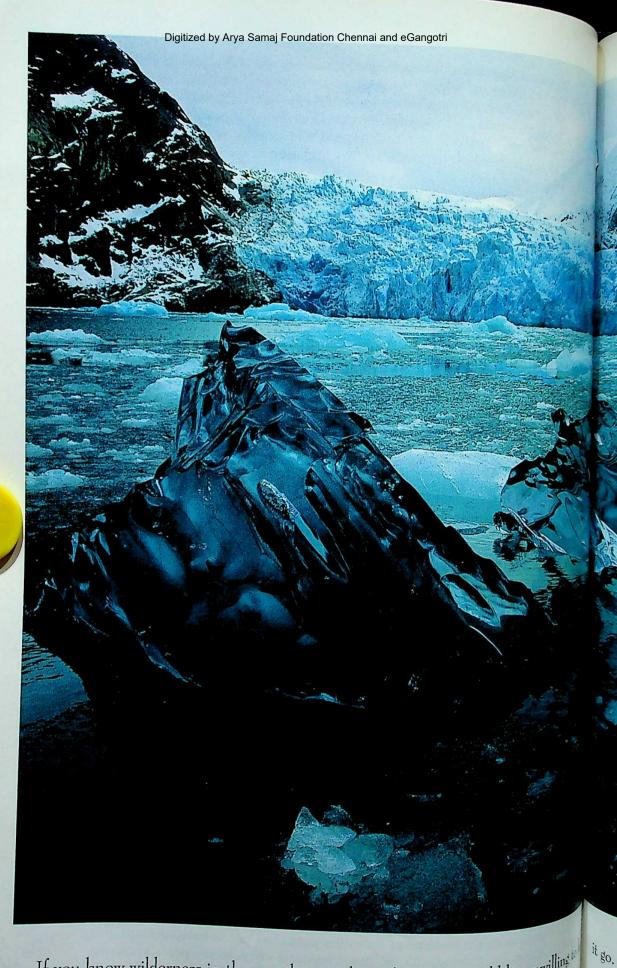
is not connected to the mainland by bridge or causeway. For that reason, among others, much of Cumberland was acquired by the National Park Service in 1972 and declared a national seashore. Ten years later, at the behest of conservationists who feared the Park Service might develop the seashore for intensive recreation, Congress designated nearly 9,000 of its 36,400 acres as statutory wilderness. In so doing, however, Congress recognized that certain nonconforming uses and structures, such as the narrow unpaved road that runs the length of the island, could not soon be abandoned. They would have to be phased out over the years. Cumberland, in effect, would be a kind of evolving wilderness. Thus, even

now, motor vehicles belonging to the Park Service and private landowners have access to this road and to the wide-open avenue of the beach. Backpackers complain that the vehicles disrupt their wilderness experience.

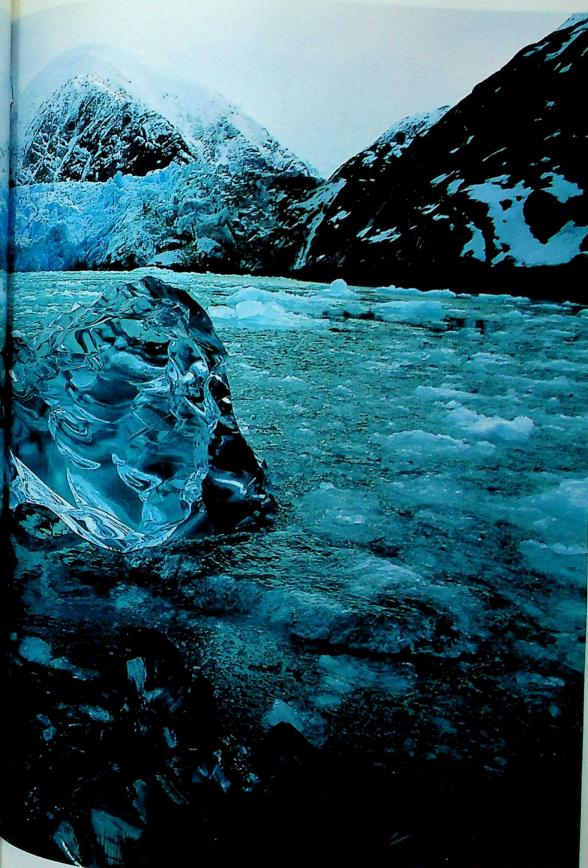
But some advocates of a wild Cumberland are more concerned that the island's ecological stability has been put at risk by feral hogs and horses. The hogs, introduced as provender in antebellum days, compete with native wild-life for the island's slim pickings, including sea turtle eggs. Park Service trappers and marksmen have had scant success controlling the porcine population. The free-ranging horses, some descended from Arizona mustangs imported early in this century to entertain wealthy landowners, now number nearly 200 and are decidedly competitive for browse with white-tailed deer. The sight of mares and stallions trotting along the beach has proved so entertaining to visitors that the Park Service is loath to have the horses removed.

One day on Cumberland I called on Carol Ruckdeschel, a biologist who lives at the island's north end, beyond the wilderness area, collecting and autopsying the carcasses of sea turtles washed up on the beach. Ruckdeschel, like many of the island's two dozen residents whose tenure predates the seashore designation, retains the right to live out her (Continued on page 21)

1995

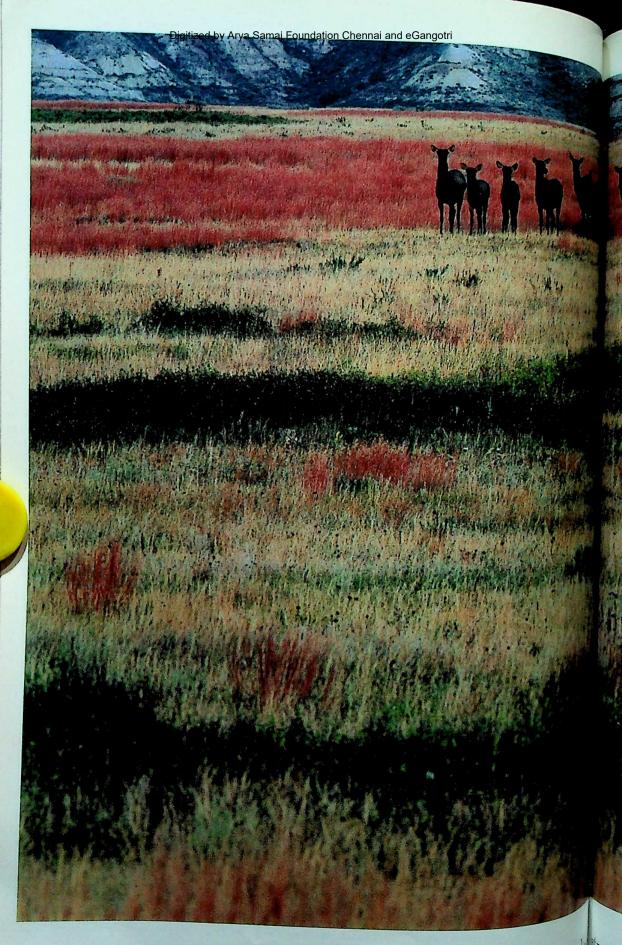


If you know wilderness in the way that you know love, you would be unwilling the CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar



TRACY ARM-FORDS TERROR WILDERNESS, TONGASS NATIONAL FOREST, ALASKA PETER ESSICK, AURORA & QUANTA PRODUCTIONS

it go. We are talking about the body of the beloved, not real estate.

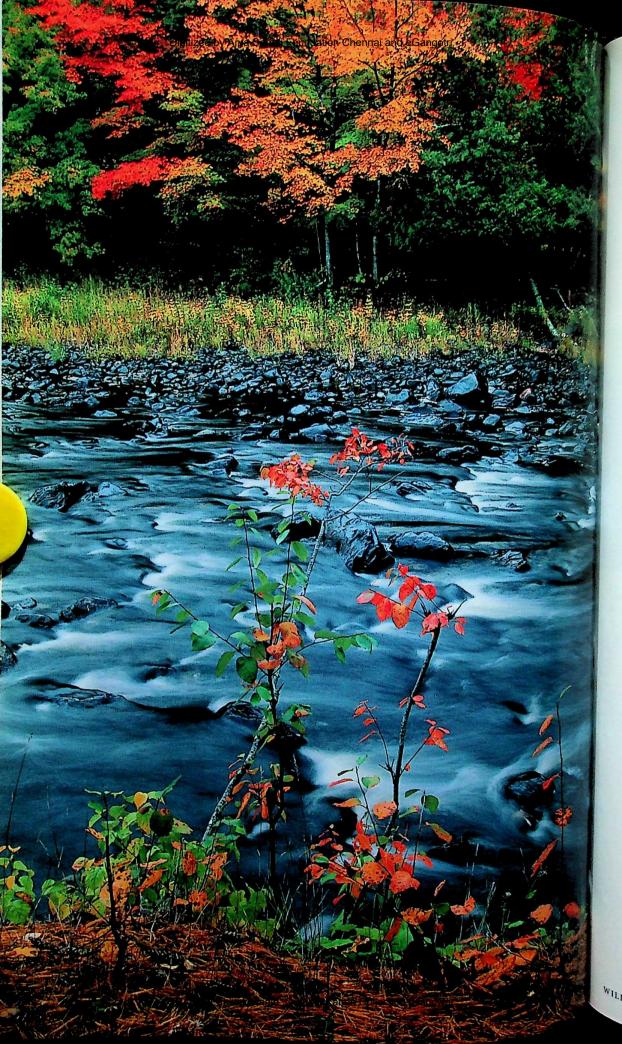


We did not think of the great open plains, the beautiful rolling hills, and with the arms



THEODORE ROOSEVELT WILDERNESS, THEODORE ROOSEVELT NATIONAL PARK, NORTH DAKOTA

··· as "wild." Only to the white man was nature a "wilderness."



life here and to drive on the beach and the road. An ardent wilderness booster, she tries to keep her transportation profile low to the ground, the preferred ride being a one-cylinder all-terrain vehicle.

"If you just look ahead a hundred years or so," Ruckdeschel said, "there'll be something special here. We'll all be dead and gone—no more people living out here. And no vehicles. Hell, right now the hogs and the horses cause more damage than the vehicles do."

ow, on KOOTZNOOWOO, Cline and I have polished our dinner plates, poured a nightcap, and are silently roasting our separate thoughts over glowing coals. For my own part, I'm wondering how accessible wilderness can be, and still be Wilderness.

Sure, cracking Kootznoowoo was easy with a floatplane. But if this were a wilderness constrained by the rules of the lower forty-eight, to reach Windfall Harbor we'd have been obliged to endure either a two-day paddle by sea kayak or an arduous 25-mile trek from Angoon. Which leaves me in a somewhat vulnerable position as I declare that I cannot understand why some critics of statutory wilderness regard restriction of motorized access as an act of discrimination against the old, the infirm, and the vehicularly pampered. Thus, these scoffers argue, access to wilderness is enjoyed only by the physically elite.

As one who assuredly is not among that elite, I affirm that neither age nor infirmity barred me last year from paddling a canoe into Florida's Juniper Prairie and Everglades Wilderness Areas, riding a horse into New Mexico's Gila, or poking afoot into the Otter Creek wilds of West Virginia far enough to absorb a short measure of solitude.

But, of course, there are many wildernesses where canoes, kayaks, or horses don't work, steep mountain places accessible only to the hardiest hikers. Last year I stood at the edge of a few of those places, looked in-or, rather, up—and, without too much regret, tipped my hat to the lost opportunity. It was like that with the Enchantments, in the Alpine Lakes Wilderness of Washington State.

I had heard about the Enchantments from a mountaineering friend in Seattle; about stark clusters of granite spires and glacial lakes and waterfalls and heather meadows and gnarled larches with needles that glowed like gold splinters in October; about the area's Lost World Plateau and the Knitting Needles and Dragontail Peak and Witches Tower. "The way is long, steep and grueling," one guidebook warns. "A strong hiker needs at least 12 hours to reach the high lakes. The average hiker takes 2 days. The rest never make it."

I knew where that left me. So early one morning in June I dropped by the Wenatchee National Forest ranger station in Leavenworth, Washington, to see if I could find a strong or average hiker waiting there to pick up a permit to camp overnight in the Enchantments. Because of lingering snow at elevations over 6,000 feet—the Cascade summits here top 8,000—June is not the most Popular month for backpacking the Enchantments. But I was in luck. Mark Simon and his friend Heather Wolfe, permits in hand, were getting ready to head out. They both looked strong enough, in their early 20s, traveling light with 30-pound packs, food for three days. They'd take it slow, Simon said, because of his bad knee. "Blew out a ligament skiing last winter," he explained.

How did he feel about the Forest Service restricting overnight use with

permits issued by advance reservation or daily lottery? Did he feel that was an infringement of his liberty to use public land? "It's an inconvenience, that's all," he said. "The permits are a good thing. Without them, I don't think the Enchantments could withstand all the use they'd otherwise get."

I wished Simon and Wolfe happy hiking, paid my respects to the Leavenworth district ranger and her wilderness manager, and then drove out along the Icicle Creek Road to the Enchantments trailhead at Snow Creek. There was scattered dead timber on the slope that the trail ascended in switchbacks. I was hoping to catch a last glimpse of the couple working their way up the mountain, but already they were out of sight over the first ridge. Forget that blownout ligament. Those two were better than average. And I was happy for them, because I knew they were going to make it to the high country.

ENTS DO NOT AGREE with me. Flat on my back in a sleeping bag, I much prefer the starlit sky to a nylon roof, except when the bugs are biting or the clouds are spitting—and that's what the clouds are doing to our tent tonight in the Kootznoowoo rain forest. A steady drizzle it is, just enough patter to muffle the imagined footfalls of insomniac bears. I try to think of other nights untented-no biting bugs, no spitting clouds, no grizzlies. I think of a night flat on my back beside the Middle Fork Gila River, with the rimrock framing a wedge of sky flecked with a million stars.

It was a pilgrimage, that horseback trip into the mountain backcountry of southwestern New



CONGRESS CALLED WILDERNESS A PLACE "WHERE MAN HINSE! IS A VISITOR WHO DOES NOT REMAIN." MAN'S TRASH IS ANOTHER STORY, PULL TABS LIKE THIS ONE IN ARIZONA'S HUMMINGBED SPRINGS WILDERNESS HAVE BEEN OUT OF USE HERE SINCE 181

Mexico. If I was going to celebrate the idea of federal wilderness, I had to go to the place where it began—sort of like celebrating the Fourth of July beside the Liberty Bell at Philadelphia's Independence Hall.

The Gila—pronounced HEE-lah—is both river and wilderness tucked into a national forest of the same name. Elevations run from 5,000 feet on the floor of some canyons to nearly 11,000 on top of Whitewater Baldy in the Mogollon Mountains. Cool forests, sparkling trout streams, elk and bighorns and javelinas, black bears and mountain lions, solitude for those who seek it and scenery enough to knock your specs off. I went out of Gila Hot Springs with outfitter Becky Campbell, her husband, David Snow, and Charles Little, an old friend and writer with much savvy about matters of the land and why land counts in the human scheme of things. And I wanted Little's company in the Gila because he is savvy about Aldo Leopold.

We rode in through piñon and juniper country, down the twisty Little Bear Canyon to the Middle Fork, and then upstream between towering red rock cliffs and riverine sycamores to a parklike spot with plenty of dead Gambel oak for the cook fire and deep ponderosa shade for hobbling the stock. I thanked my horse, Tater, for the ride, staked out a stargazer's spot for my bedroll, and

perched on the riverbank, watching for signs of insects and trout. Little sat down beside me, pointed at a big pool upstream, and said, "I'll bet you anything Aldo Leopold wet a fly line right there about 80 years ago."

Why 80?

ANOTHE

IGBIRD ICE 1983 "Because," said Little, "that's about the time Aldo Leopold got into this country first time around."

Leopold's is such a runaway story, we'd best pull back on the reins. He hailed from Iowa, long after the sodbusters had tamed the prairie. Maybe he got a taste of the wild during boyhood summers in the Les Cheneaux Islands, topside of Lake Huron; every time he looked north from there, he imagined boreal mysteries beyond the horizon. By and by he went to Yale, joined the Forest Service, was posted to Albuquerque, rode into the Gila on survey patrol.

One day in 1919 Leopold had a talk with another young forester named Arthur Carhart. A landscape architect by training, Carhart had this crazy idea that the shorefront of Trappers Lake, up in the White River National Forest of Colorado, ought to be preserved for its scenic value rather than developed with roads and summer cabins. It was an encounter of kindred spirits. On behalf of scenery, Carhart would prevail in preserving Trappers Lake against the incipient roadbuilding mentality of the Forest Service, while Leopold within a few years would be advocating an even larger heresy-the setting aside of wilderness areas in national forests for public recreation. And what sort of area did he have in mind? An area "big enough to absorb a two weeks' pack trip," he wrote; a place "devoid of roads . . . or other works of man." Such as? Such as "the headwaters of the Gila River," a half million acres that could absorb a hundred pack trips a year "without overcrowding." In 1924, by administrative decree, the Forest Service designated a portion of the Gila as its first wilderness. (Today the Gila and the adjoining Aldo Leopold Wilderness embrace nearly 1,200 square miles.)

From Leopold's earliest writings—and from the Gila—the wilderness movement gained momentum, inducing the Forest Service to honor roadless areas as much as commercial clear-cuts and enrolling such influential leaders as Bob Marshall, a co-founder with Leopold of the Wilderness Society, and Howard Zahniser, who as that society's executive director would spearhead

the legislative effort resulting in the Wilderness Act of 1964.

"And now," Charles Little was saying beside the Gila River, "we have a wilderness system, but I'm not sure we yet understand Leopold's wilderness idea. It's not just a matter of protecting land because it's scenic or because we can pack in for three days to catch trout. 'Land is a community,' Leopold wrote. Its waters, soils, plants, animals all fit together not for our sake but for their own."

"Trouble is," I said, "that's what's driving some people right up the wall."

N RECENT YEARS I have encountered more than a few individuals who feel uneasy, if not threatened, when bureaucrats or new-wave biologists speak of preserving wilderness ecosystems at the expense of human use. That evening with Little beside the Gila River, we listened to the complaints of our outfitter, who was deeply concerned that officials in faraway places were making decisions—about livestock grazing in the Gila, for example—better left for the local folks to sort out. And one month later, in the northern Cascades of Washington State, I heard similar tales about government regulation from another outfitter, at a hideaway place called Stehekin.

For a perfect little community at the edge of wilderness, you'd be hard Put to find one more remote than Stehekin. It sits up there at the top of that

landlocked fjord, Lake Chelan, tucked into one big North Cascades National Park wilderness—the Mather—and bracketed by two other areas administered by the Forest Service—Glacier Peak and Lake Chelan–Sawtooth. Wilder. ness Village, some people call it, though not the handful who live there year-round served only by boat and floatplane, the lake so deep and windy it

Cliff Courtney is the proprietor of the Stehekin Valley Ranch a few miles beyond the village, a hop and a skip from the Mather Wilderness. Courtney runs white-water raft trips on the Stehekin River and, with his brother Cragg, horse trips into the mountains. Some of the trips are called Hike & Like It, the idea being that you hike while a horse totes your gear.

One morning I sat with Cliff out behind the ranch's main lodge, looking across a stock corral and a field of new rye and over the spruce tops to mountain snowfields almost blinding in their whiteness. He was telling me about

government regulations.

"They're talking about cutting us down to 12 sets of eyes," he said. "That means six horses and six people per trip. Not much for earnings when we used to be able to take 20 to 30 people a trip." Courtney took a deep breath and said, "You keep making it harder for people to be a part of wilderness, and you'll lose them. Okay, I may be grinding my own ax, but it seems to me the best thing you can do for wilderness is to show it to people and share it with people and let them see how great it is."

Courtney's father, Ray, who died in a trail accident some years back when a loose packhorse knocked him off a 200-foot cliff, helped form the North Cascades Conservation Council and led Sierra Club trips to promote wilderness designation. But later, Courtney said, his father felt betrayed when con-

servationists pushed for tighter controls on wilderness access.

"In a lot of people's minds," Courtney went on, "there's a real question whether all this overlayering of regulation is really to protect wilderness or part of some greater plan to keep people out. I find fewer and fewer everyday Joe and Sally Sixpacks who can relate to the wilderness. They haven't been there. For a lot of them, wilderness is just a word that means No."

T IS MORNING in Kootznoowoo. The rain has stopped, the tide has ebbed. David Cline and I are walking up the beach toward the head of Windfall Harbor, toward that wide gravel estuary where we spotted one of those grazing grizzlies from the air. A harbor seal, goggle-eyed, watches us from the water. An eagle, suspicious of our approach, flees its roost at the top of a Sitka spruce. A mile away, on the other side of the harbor, a small dark spot moves slowly along the water's edge. Cline measures the spot with his eye and identifies it as a young grizzly.

Suddenly I am feeling exposed and alone on this wide-open strip of tidal cobble and glacial grit. Possibly it's that old Thoreauvian imagining againthe presence of a force not bound to be kind to me, or to Cline. Whatever it is, I like it. What I don't like are the forces not bound to be kind to wilderness.

As I follow Cline to the head of Windfall Harbor, I am thinking that the rule books by now ought to be pretty clear regarding motors and wilderness, but what about all these newfangled high-tech electronic devices that weren't even around when the Wilderness Act's language was drafted more than a generation ago? I mean what about cell phones, global positioning systems, and laptop computers? How wired can the wilderness be, and still be Wilderness?

Put that question to federal agencies, and you'll hear variations on a theme

expressed by Jeff Jarvis, the Bureau of Land Management's wilderness leader. "Sure, these items will detract from the wilderness experience, but it's the individual's choice. We have no intention of regulating these devices any more than we would regulate the use of cameras."

Wes Henry, Jarvis's counterpart over at the National Park Service, agrees, but he responds to the question a bit more critically. "People are using these things as crutches," he says. "A woman called once on a cell phone from the middle of the wilderness. She said she had blisters and was tired and wanted us to take her out in a helicopter."

Cyberspace invasion of wilderness worries some purists more than cell phones do. The way they tell it, it won't be long before our backcountry trails are obstructed by hackers hunkered over their laptops, checking their e-mail. Richard Bangs, a West Coast expeditionary entrepreneur and advocate

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TAKE ONLY MEMORIES, LEAVE ONLY FOOTPRINTS? SOMETIMES THAT'S LEAVING TOO MUCH. WITH WILDERNESS LANDS BEARING SEVEN TIMES THE TRAFFIC THEY DID 30 YEARS AGO, FRAGILE SPOTS LIKE THIS IDAHO ALPINE MEADOW CAN BE EASILY DAMAGED.

of online adventure travel, has carried the information age even deeper into the wilds. Defending the use of computers, digital cameras, and satellite communications to link a wilderness expedition to a website, Bangs wrote: "The Internet is not the death of wilderness. It may be its savior. . . . For the first time, we can showcase the beauty and magic of a wild place to a global audience, and millions can participate in a journey through it without ever breaking a branch or stepping on [fragile] soil." Bangs's cybersorties have ranged from Africa to the Antarctic.

Virtual wilderness. It may be with us sooner than we think. In Minnesota the Boundary Waters Canoe Area in Superior National

Forest now has a website designed to help the prospective visitor plan a wilderness trip. Not everyone is ecstatic. Alan Watson, a social scientist at the Aldo Leopold Wilderness Research Center in Missoula, Montana, says: "They're approaching a level of information that makes me wonder why one would want to go to that wilderness. The sense of discovery is why people go there, but discovery's gone. Risk and adventure—gone. I felt like they'd just taken the Boundary Waters away from me."

T THE HEAD of Windfall Harbor a braided stream rushes out of the rain forest through a wide and open valley edged with alder and spruce. This is where, from the floatplane, we saw the big grizzly. This morning no bear is in sight. "I'll bet you it's up there," Cline says. "Taking a nap in those alders. Bloated with salmon."

I can believe it, because this stream is bloated with salmon—thousands of them, mostly pinks, dead or dying in the shallow riffles, the last of the spawners fighting the flow with flapping tails, humpbacks atilt. What a movable feast for the seagulls, the eagles, and the bears. And what a gift to the sea as the

uneaten carcasses rot and post their nutrients down this stream to nourish invertebrates—the food supply for next year's salmon. Contact. This is how wilderness works.

But where is the bear?

"We could stroll upstream a way," Cline says.

"You could. I'll watch."

Cline splashes across a channel and takes a direction that looks discreetly sideways to upstream. Be wary of poetic justice, Cline. You don't want to deprive the Kodiak Brown Bear Trust in Anchorage of its chairman.

My friend's passage across the gravel bars puts the squabbling gulls to flight, and suddenly I find myself wrapped in a circle of silence that is punctured only by the stream that runs through it and by the struggle of the dying fish. I close my eyes and try to imagine the measure of this million acres of Kootznoowoo Wilderness, this one percent of all our designated wilderness between the Arctic and the Everglades. The devil in me asks, Do we really need it all? Isn't a hundred million acres more than enough for scenery and solitude and risk and self-discovery and genetic diversity and, as a wise woman once remarked, for securing answers to questions we have not yet learned how to ask?

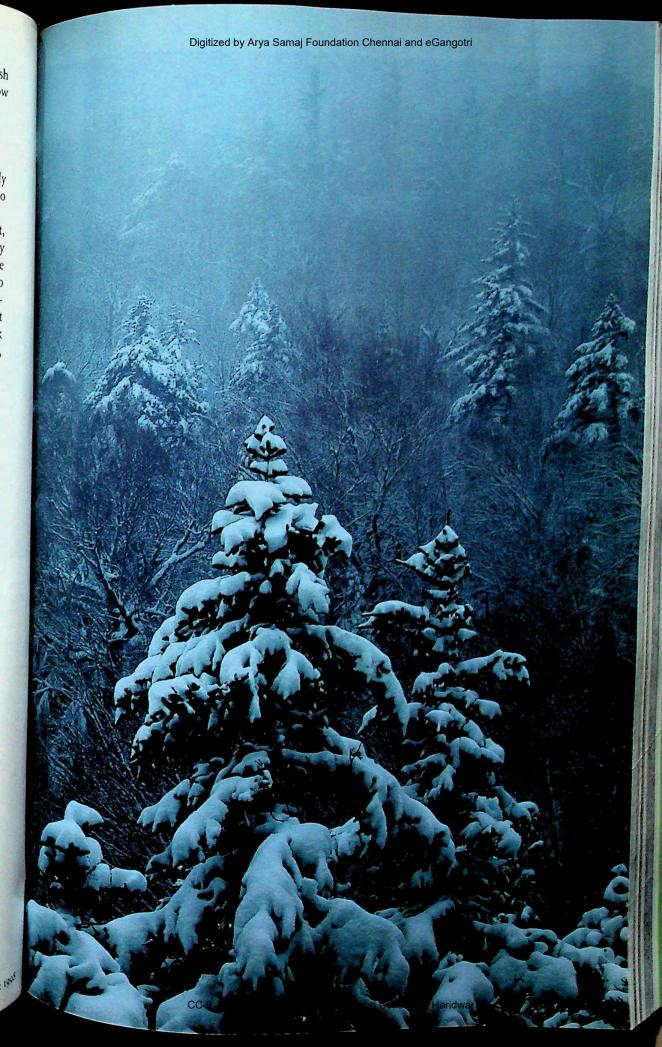
Or is a hundred million acres not enough?

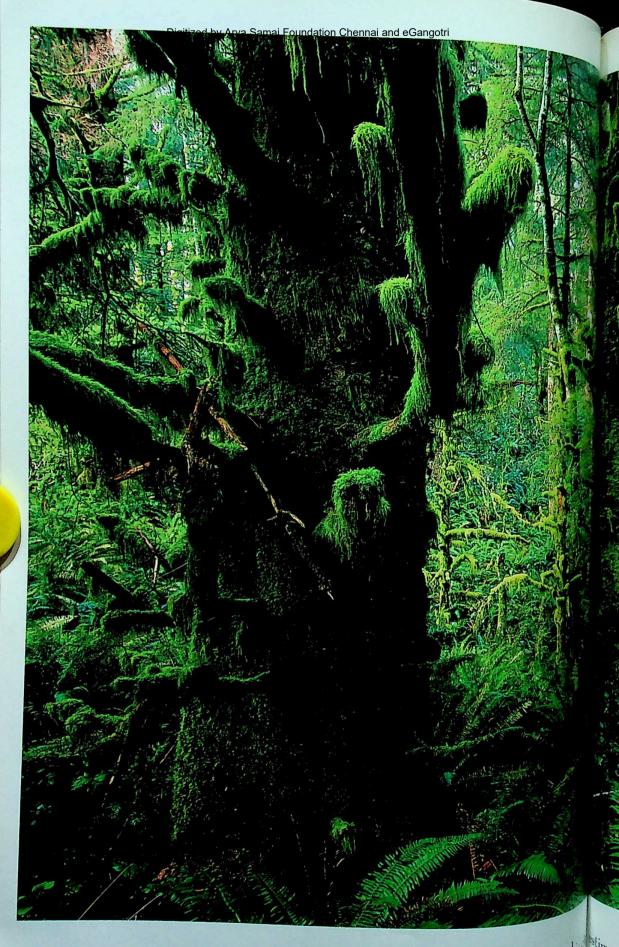
There are those—on the right hand of Congress and in the western countryside—who say we have too much wilderness already and should forthwith unhinge it from the federal estate. But others, citing the pressures and stresses on existing wildlands, argue that we could double the size of the system and still be deficient. Advocates cheer a recent Clinton Administration temporary moratorium on roadbuilding in millions of acres of national forest, thereby suspending logging and converting those lands into de facto, though impermanent, wilderness areas. They demand additional wilderness in the forests of the Northwest, the Rockies, and the Appalachians. They call on the National Park Service to complete or update its review of wilderness study areas in 27 parks, including Grand Canyon, Glen Canyon, and Big Cypress. They want the Bureau of Land Management to recommend to a divided Congress the designation of 8.5 million acres of red rock mesas and canyons in southern Utah. Some even say that 58 million acres of wilderness in Alaska is not enough; 125 million acres more should be designated.

"We have only a fraction of the wilderness we're going to need," says Gaylord Nelson, the former senator from Wisconsin, father of Earth Day, and longtime counselor to the Wilderness Society. "Our public lands are being overwhelmed by population pressures. There'll be half a billion people in this country by 2075. The rarest thing you'll find by that time will be a natural area undisturbed by the hand of man. It will be a real tragedy if we don't start now doubling or even tripling the extent of our designated wilderness."

Cline has come back from his reconnoiter with a sad sort of smile on his face. "Gets pretty narrow up there," he says, hooking his thumb at the alderedged valley behind him. "Not a good place to spook a sleeping bear."

We head back toward camp. About a hundred yards down the beach, Cline stops and turns to look one more time at the gravel flats and the long green valley tapering into the rain forest. If I know Cline—and what wilderness does to people like him—I know exactly what he's feeling. He doesn't want to leave the uncertain presence in the alders. He wants to go back up that valley, into the real world.





At the gates of the forest, the surprised man of the world is forced to leave to lea

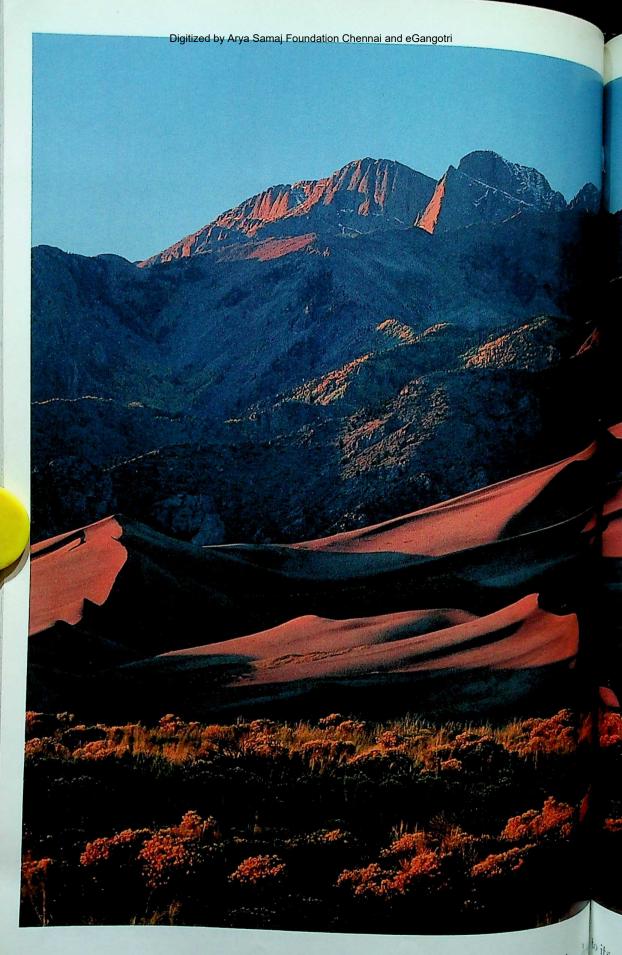


e limates of great and small. . . . The knapsack of custom falls off his back.

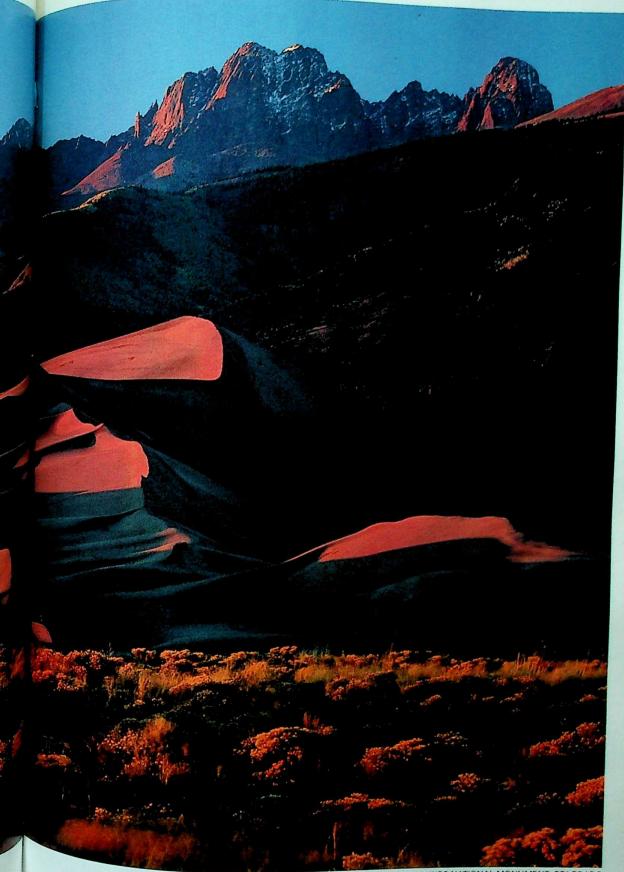
—RALPH WALDS

-RALPH WALDO EMERSON

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We simply need that wild country available to us, even if we never do more that CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar



GREAT SAND DUNES WILDERNESS, GREAT SAND DUNES NATIONAL MONUMENT, COLORADO

GREAT SAND DOM:

One of the stand look in. For it can be a means of reassuring ourselves of our sanity. . . .

—WALLACE STEGNET

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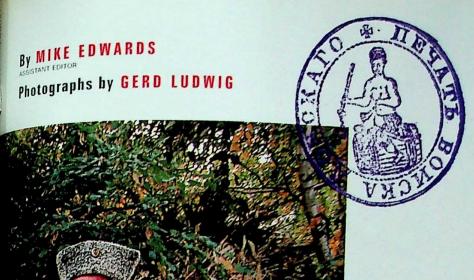
HUMMINGBIRD SPRINGS WILDERNESS, BUREAU OF LAND MANAGEMENT, ARIZONA

Today's appreciation of wilderness represents one of the most remarkable intellectual revolutions in the history of human thought about the land. . . . Wilderness has evolved from an earthly hell to a peaceful sanctuary where happy visitors can join John Muir and John Denver in drawing near to divinity. Such a perspective would have been absolutely incomprehensible to, for example, a Puritan in New England in the 1650s.

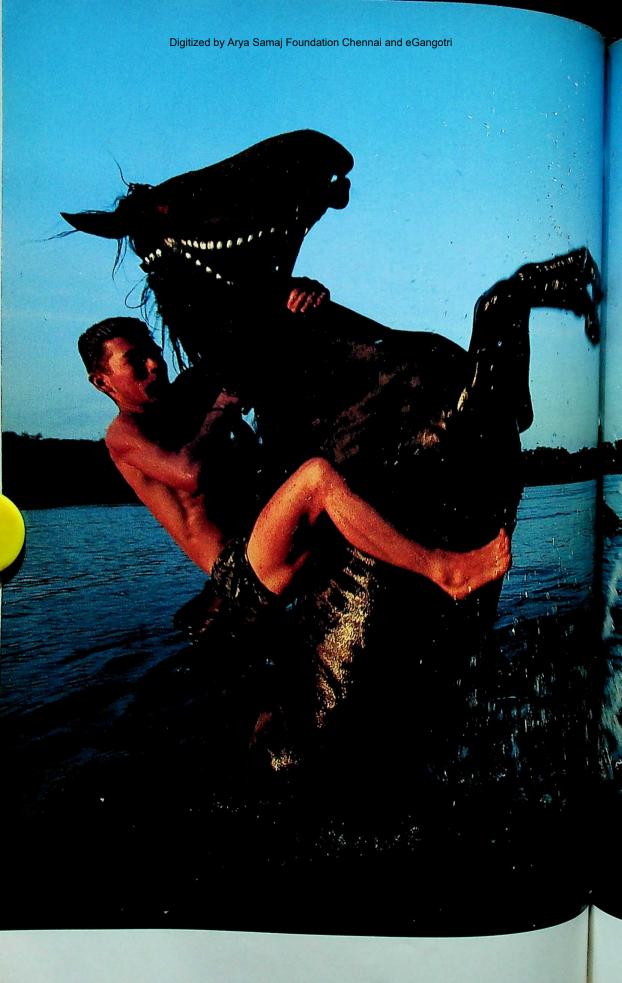
-RODERICK NASH



Digitized by Arya Samaj Foundation Chennai and eGangotri A COMEBACK FOR THE



Ardent protectors of Mother Russia—and sometimes her rebellious sons-Cossacks strike a prideful pose as they celebrate the founding of Stavropol as a Cossack fortress. One of the largest subgroups of this warrior caste, the Don Cossacks, who received an official seal (above) from Tsar Peter the Great, originated as a band of mercenaries along the Don River. Repressed in Soviet times, Cossacks battle today for power to shape their destiny.





n the cobbled square in front of the cathedral of Novocherkassk, in the sprawling steppe of southern Russia, 3,000 men stand at attention. Some are in army fatigues, but most wear the traditional uniform of the Don River Cossacks, an olive tunic and blue trousers with red stripes down the legs.

Their flags are emblazoned with crosses, sabers, and the double-headed Russian eagle. "Wounded But Not Conquered" is the motto on one, which bears an old Cossack symbol of defiance, a stag still standing though an arrow has pierced its back.

A band strikes up, and the Cossacks pass before a bearded fellow who is their ataman, or leader. Their ranks waver as they try to execute a turn while marching ten abreast. "We're not in the village entertaining ourselves!" shouts the parade marshal. "March straight! Don't swing your arms like you're throwing something away!"

As I watch from the cathedral steps, it seems that nearly six centuries of history are passing before me. Cossacks trace their origins at least to the 1400s, when their traditional homeland, the steppe of Russia and Ukraine, was virginal grassland that belonged to no government—"an ocean of green and gold, sprinkled with millions of different flowers," as Nikolay Gogol wrote in "Taras Bulba," the story of a Cossack chief.

They were not an ethnic group but an agglomeration of brigands and soldiers for hire; a possible meaning of "Cossack" is "free warrior." From a few bands of horsemen and pirates they swelled into a warrior caste that numbered nearly five million by the beginning of the 20th century. At times Cossacks fought against imperial Russia, but mostly they served alongside the tsars' soldiers. Cossacks were in the vanguard of the legions

Photographer GERD LUDWIG has worked with MIKE EDWARDS on several NATIONAL GEOGRAPHIC articles about the former Soviet Union, including "A Broken Empire" in the March 1993 issue.

that colonized Siberia, hurled back Turkish invaders, and captured the Caucasus and Central Asia. In Russia's war with Napoleon in 1812-14, Cossacks not only helped chase the French army from Russian soil but trium phantly rode all the way to Paris.

Chests swell across the square as a speaker extols these exploits, and even the threadbar World War II uniforms worn by a few pension ers seem splendid. "Cossacks created Russia," an officer boasts to me. And many years to create Russia anew, strong and righteous with law prevailing against the near anarchy that afflicts Russia today.

From St. Petersburg on the Gulf of Finland to Vladivostok on the Sea of Japan, these warriors are marching again. More than 400 Cossack groups have sprung up, some enlisting only a few dozen "sabers," as Cossacks call themselves, and others attracting thousands. The ceremony at Novocherkassk once capital of the huge Don voisko-meaning host, or community—marked the enrollment of that legion as a sort of home guard, government sponsored. Many other units are independent, not wanting to swear fealty to a government they blame for Russia's lawless ness and chaos.

Some Cossacks have taken up arms again. In the war against Chechnya, 800 were hired to fight with the Russian Army when that Call casus state tried to wrest its independence in 1994-96. Some aided the Serbs in the former Yugoslavia. At home a few have verged into vigilantism, attempting to enforce public order with an old Cossack weapon, the whip

Although Cossacks were savagely repressed after communists seized power in 1917, an estimated five million Russians Claim Cossack ancestry. Tens of thousands of other descendants live in Ukraine and ex-Soviet Central Asia, but few of those are organized

Many of the Cossacks I met in Moscow and across the wide steppe gazed nostalgically back to a time they believe was better than the present—say, to the 19th century, when NATIONAL GEOGRAPHIC, NOVEMBER 1990

Digitized by Arya Samaj Foundation Chennal and eGangotri authority, brave, good-natured, hospitable . . . indefatigable, and intelligent.

-AUGUST VON HAXTHAUSEN



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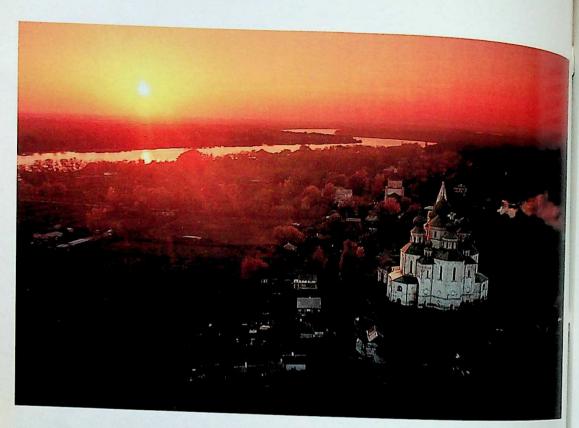
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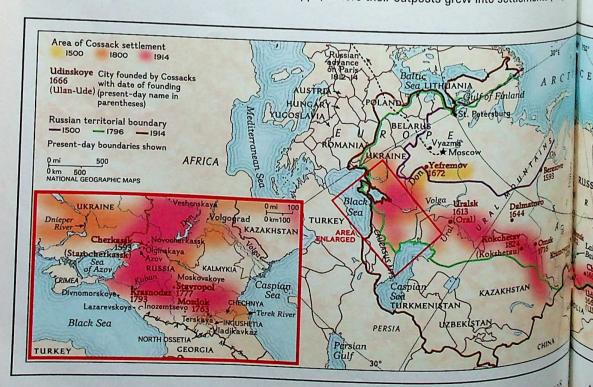


Wooden domes top Resurrection Cathedral in Starocherkassk, early capital of the Don Cossacks, one of ten government-sponsored Cossack groups today. Perhaps offshoots of Mongol invaders, Cossack bands swelled with brigands and runaway serfs from tsarist Russia. The crown later used Cossacks to guard borders and lead Russian expansion across the steppe, where their outposts grew into settlements (map)

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Cossacks possessed land and enjoyed a measure of freedom in managing their affairs. "A Cossack house was always clean," a fellow named Ivan Zolotaryov told me. "It might have a clay floor, but there were herbs on the floor for aroma. We want to revive the Cossack spirit and have communities governed by the oldest person again, with children staving home and learning to farm." But sons also would be expected to serve in the military, as virtually all Cossack sons once did.

o be ready to fight was the essence of Cossack identity from earliest times. But who the earliest warriors were is still debated in the steppe. "It seems they were not Russians," Nikolai Manchenkov offered. "They may have been Scythians or other warrior nomads." Nikolai is ataman of Olginskaya, a village close to the Don. Like most Russian villages, it is grooved by unpaved, rutted streets. We sat under a walnut tree beside his small brick house. Chickens wandered and clucked.

Many Cossacks like to claim descent from the fierce Scythians, who migrated from Central Asia in the seventh century B.C.

But historians generally believe that Cossacks appeared in the 1400s A.D., and it's likely they were Tatars—Tatar being the Russian name for the Mongols who had invaded the steppe and for the tribes dwelling there. With Mongol rule collapsing, Tatar warriors roamed at will. Records mention Tatar Cossacks hired by the princes of Muscovy to guard their lands against raids by other Tatars. Even today Cossack speech is sprinkled

with Tatar words, such as "ataman." Olginskaya is a stanitsa, not a village. Kazak— Cossack—was a Tatar word too. (Scholars still debate whether the Central Asian nation of Kazakhstan got its name from this word's root or an unrelated source.)

Slavs drifted into the steppe no-man's-land, for game and fish were abundant and booty could be seized from caravans and from boats plying the Don and Volga. The Zaporozhians, a famous Cossack host in Ukraine, preyed on Turkish ships in the Black Sea. Don Cossacks voyaged with the Zaporozhians, and Tatars rode beside Slavs.

Many Slavs who swelled these bands in the 1500s and 1600s were fleeing serfdom in Russia and Ukraine, which was falling prey to feudal Polish nobles. Others were Old Believers. schismatics ousted from the Russian Orthodox Church, and even Germans and Scandinavians, Hence, Nikolai and many other Cossacks see themselves as a people apart culturally and genetically, mostly Russian but not quite.

Nikolai added in support of that view: "One of my great-grandfathers had a Turkish wife. He brought her back from a raid." This may explain why Nikolai's eyes are brown, not the more common green or blue. "There were a lot of men on the Don," he explained, "but there was a deficit of women." Cossack raiders bore off women from Persia too.

There are stories of Cossack women fighting beside their men, but mainly their role was passive. They bore children and tended the farm while their men were away, sometimes for years. The role of women still is a passive one, although a few uniformed women have marched in parades recently, and some have joined choirs that sing old

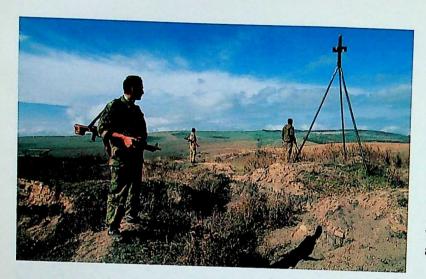


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Rifles at the ready, Cossack villantes in North Ossetia defy a Russian ban against possessing military firearms as they guard the border with Ingushetia. The two regions clash over territory in Russia's Caucasus region. Honors to Cossack troops who fell in World War II came in 1997, when newly discovered remains of some 300 soldiers were gathered for reburial (right at Vyazma, west of Moscow.

Cossack ballads. As Nikolai and I sat in his yard, his wife emerged to bring us cool drinks but did not join us.

Nikolai spoke of the days of his ancestors as if he'd lived then. "We had our own land. At the annual *krug* [meeting] important decisions were made. Land was distributed. Stealing was punished; the thief was whipped in the *maidan* [square]. All we demand now is the freedom to revive our old way of living."

Some Cossacks have joined the revival in hope of regaining land. Olginskaya's Cossacks have been granted 114 acres, a fraction of what they once possessed. It is parceled to families who want to farm commercially. So far the land has produced more woe than wealth. Agriculture is a shambles in Russia; everything a farmer needs—tractor, fertilizer, pesticide—is dauntingly expensive.

In the fields Nikolai snapped off a cucumber for me. It was sweet but small, and the vines were anemic. Nearby, however, was a six-acre patch of robust cabbage. "But nobody buys it," Nikolai moaned. He had expected government agencies to purchase the crops; Cossacks had been told they could compete with other farmers to supply the army, for example. But government agents didn't come.

"Why don't you truck your vegetables to Moscow?" I asked.

"We tried that last year," Nikolai answered.
"We sent two trucks loaded with eggplant.
They were stopped on the highway by men with guns. They said, 'You'd better turn

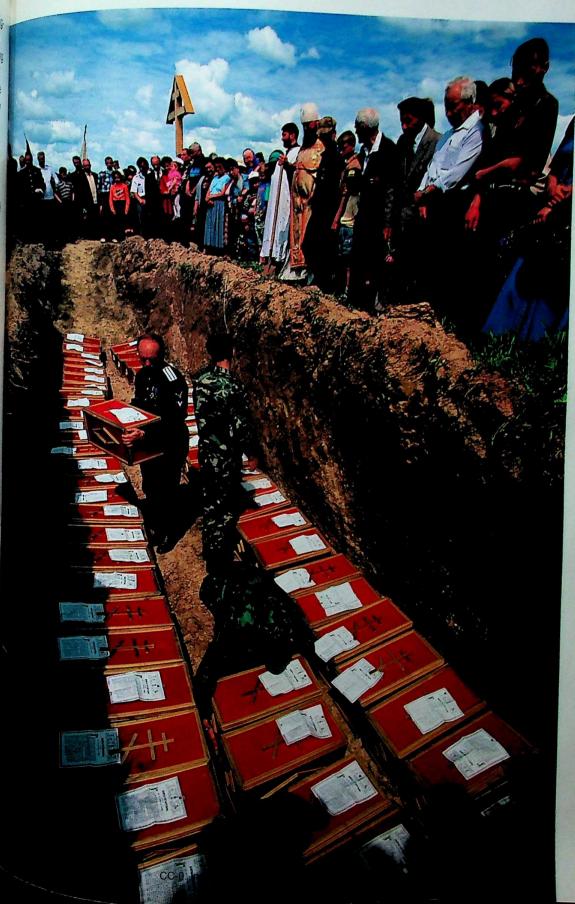
around and go home.' They had their own trucks there." The armed men paid for the cargo but not as much as the Cossacks could have earned selling it themselves. "The Moscow market is controlled by some mafia gang," Nikolai concludes, probably correctly.

His face clouded. "A Don Cossack used to defend his house, the river, and Russia," he said. "What should I defend? My house is built of bricks stolen from a collective farm. The Don River doesn't belong to me—I need a license even to fish. And Russia..."

He didn't finish. But I know Nikolai loves Russia, in spite of all. When Boris Yeltsin barricaded himself in the Russian White House in August 1991, defying hard-line communists who were trying to seize the Soviet government, Nikolai flew to Moscow unbidden to join the throng defending the building.

few miles from Nikolai's stanitsa a bounger of nine green domes rises over the Don. They crown the cathedral of Cherkassk, capital of the Don voisko from 1644 until the early 1800s, when Novocherkassk (New Cossack Place) was built and the original capital renamed Starocherkassk.

What, I wonder, did the unruly citizens of Cherkassk feel when in 1709 a ship bore the gangly figure of Peter the Great into their midst? Foreboding, surely, for some of these men had sided with a firebrand named Kontrati Bulavin, who had just led thousands of Cossacks in a (Continued on page 1)



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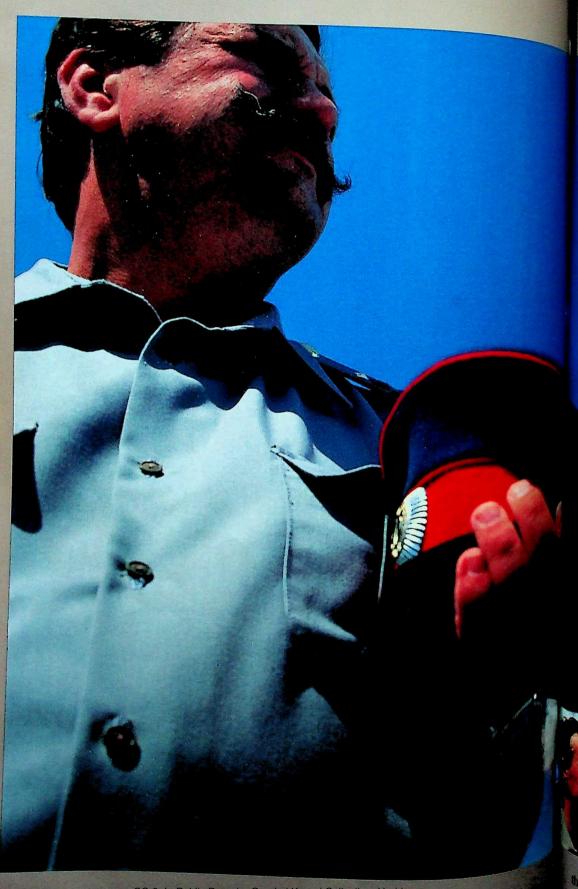
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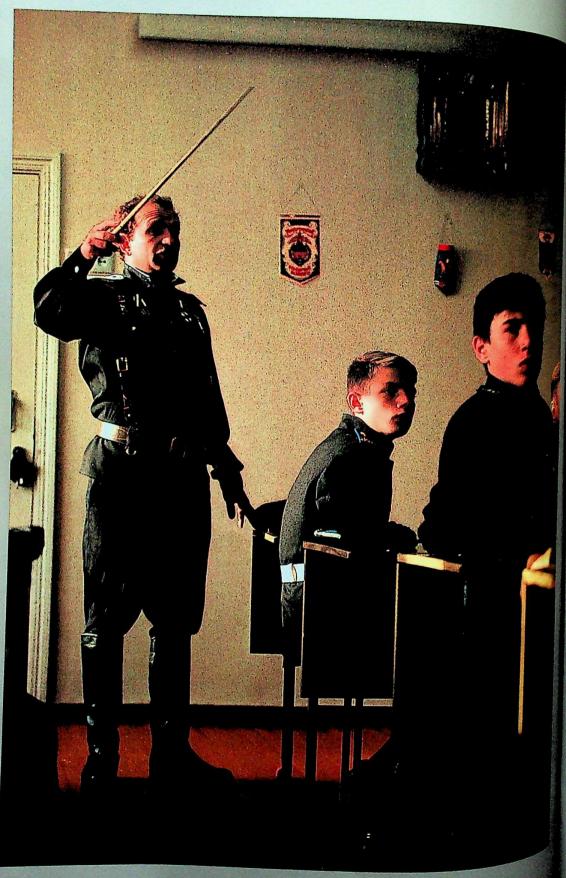


Looking sharp as his saber, a fresh-faced soldier witnesses a ceremony marking Russia's recommendation.

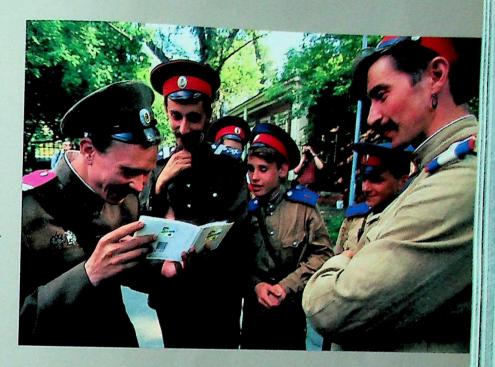
Forging the next generation

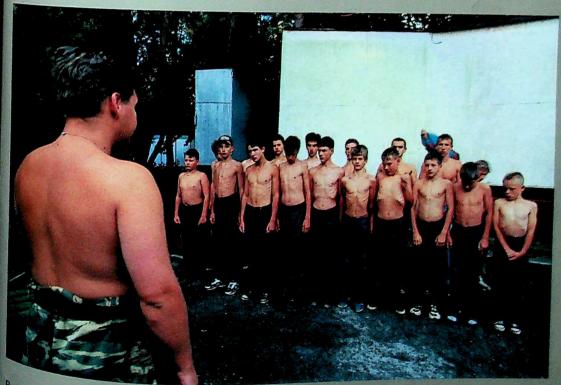


Tradition and discipline



Conducting his lecture, Anatoliy Kuznetsov (left) tells cadets at the School for Cossacks and the Caucasus Nations in Inozemtsevo how Cossack territory shifted through the ages. Photos of young trainees draw laughs at a Moscow gathering (right); an earring signals that Mikhail Chernikov, at right, is the only male supporting his family, excusing him from hazardous duty.





Black Sea. Long days are filled with close-order marching drills, target practice with air rifles, and policing the campground's perimeter. In some Cossack groups the military mind-set traditionally was instilled in the on a boy's 40th day of life, a tiny saber was hitched to his side.

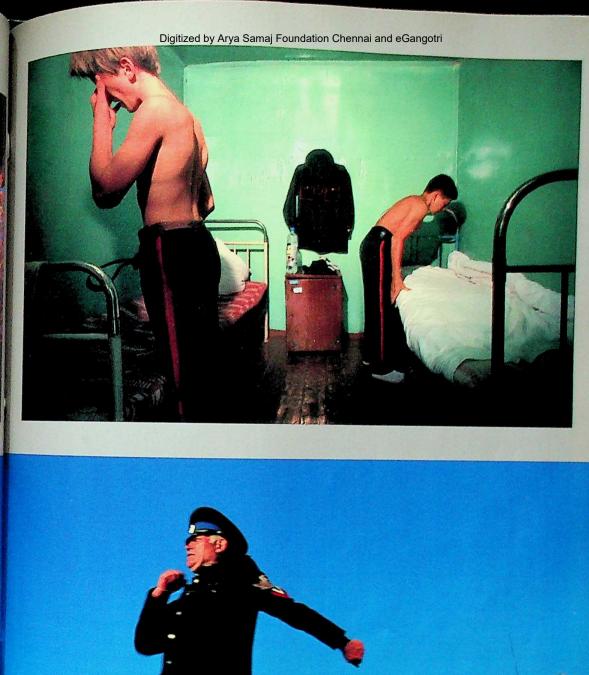


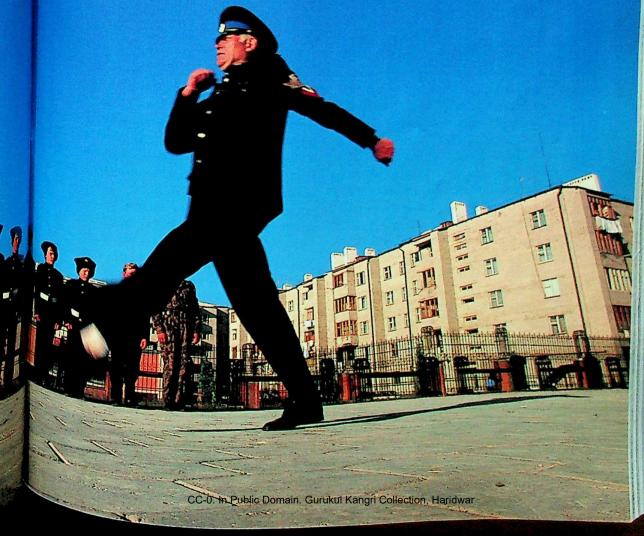
From tenderfeet to warriors

Chin up, shoulders back, a child is fitted at the Royal Cossack Cadet Academy in Novocherkassk (above), where full-time tailors tend 260 fast-growing boys. Rising at dawn (above right), cadets are Cossack 24 hours a day. Established by Tsar Alexander III in 1883, the academy was closed by Stalin in 1933, then reopened under Yeltsin in 1991. At the Cossack school in Inozemtsevo, marching instructor Aleksandr Salamakhin teaches cadets to put snap in their step.

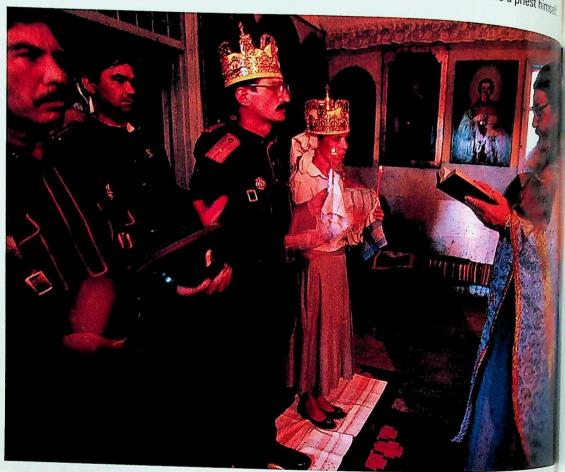
Sometimes seen in public places attempting to maintain order with whips, Cossacks reassure many crime-weary Russians but intimidate others, who recall that pogroms against Jews in Ukraine are among the dark chapters of Cossack history.







Twice-taken vows unite Eduard and Svetlana Yadykin, a Cossack couple married in a civil ceremony, then again by an Orthodox priest. This sanctified west ding was necessary for Eduard to heed his calling and become a priest himself.



(Continued from page 42) bloody campaign against imperial encroachment.

The relationship between Cossacks and Russia had long been uneasy, with terrible violence in the 1660s. Though the tsars embraced Cossacks in time of peril, exhorting them to hurl back invading Turkish armies, they also schemed to reduce them to vassalage. Peter urged his nobles, already enraged by the loss of thousands of serfs who had fled to Cossack territory, to claim Cossack lands.

When troops came to round up the fugitive serfs, Bulavin fought them. Tsar Peter retaliated by sending more troops, who burned villages and hanged the inhabitants. Defeated in battle, Bulavin shot himself.

"A few months later, when Peter came to Cherkassk, he brought the head of Bulavin, pickled in alcohol, and put it on a pole in the square," historian Mikhail Astapenko told me. While the Cossacks contemplated the gruesome visage of their leader, Peter washed his hands and, in a gesture of solidarity, laid a few bricks for the cathedral whose domes float over Starocherkassk today. The Don Cos sacks could keep their lands and some of their freedoms, Peter decreed, but henceforth they would soldier for Russia.

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The Cossacks of Ukraine also resisted domination, twice defeating Polish armies in 1648. Then the victors, joined by serfs and peasants, rampaged across the land, slaughtering not only the hated Polish landlords but thousands of other people, particularly Jews, who were also seen as oppressors. The Cossack chieftain Bohdan Khmelnytsky briefly led an autonomous state. But in 1654 he made an alliance with Russia—a fateful move, for Russia would gobble up his territory and obliterate Cossack rule from Ukrainian soil.

Russian Cossack rule from Ukraine Russian Cossacks served the tsars lovally until disillusion set in after four years of carnage in World War I. Some applauded the communist takeover in 1917 and joined the

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Reds in the fierce civil war that erupted afterward. Most Cossacks, however, threw in with the White Russians, who fought the Reds.

And some warred on both sides. In his great novel, Quiet Flows the Don, Mikhail Sholokhov's Cossack hero, Grigory Melekhov, turns communist, then changes sides and fights the Red Guards terrorizing stanitsas. Such events took place in Sholokhov's homeland, the middle reaches of the Don, where the steppe rises, lowa-like, in easy waves.

"Cossacks changed sides constantly in the civil war," Aleksandr Sholokhov, the author's grandson, told me. "Some were White first, then Red, then pink. Everything was in chaos, and they couldn't understand what was going on in the country."

Though not a Cossack, Sholokhov peopled his novel with Cossack friends. Grigory is modeled on an officer who joined the Reds, then fought them—and was executed as the communists set out to eradicate Cossacks forever. In the 1920s and 1930s two million Cossacks—about half their total—were killed, jailed, or shipped off to Siberia.

Parts of Sholokhov's book had to be reviewed by Josef Stalin himself before they could be published, for the author had committed the blasphemy of characterizing the Red Guards as murderers and rapists. Some passages appeared only after the Soviet Union collapsed. Sholokhov nevertheless won a Nobel Prize in 1965.

Today in the stanitsa of Veshenskaya his two-story home—a virtual mansion in rural Russia—is a museum, and a nine-mile-long strip of land on both sides of the river is preserved in his honor. It is indeed a quiet Don there, flowing dreamily at sunup under a diaphanous mist. Rowboats move upon the surface like water spiders, as geese waddle

down to the edge, honking joyously.

I found the people of Sholokhov's region still divided. "My grandfathers were White,"

Said Alexei Turilin, Veshenskaya's former atahands as if intending to crush bones. "I am World War II Cossacks generally leaped

to defend the motherland, even if it meant fighting under the Soviet banner—though several thousand fought on the German side, as did other Soviets embittered by repression.

Vasily Ovcharov was just 16 when he was drafted in 1943. I met him in a bungalow beside a quiet Veshenskaya street. He is portly now, but his wartime photos show a trim soldier with hat worn Cossack style, on the back of his head.

Vasily was assigned to a cavalry unit. But there was a shortage of mounts. "We had to send men to Mongolia for horses," he said. "Those horses were strong—they could break any rope." He named his first one Mongolka, to honor her origins. "She was a great horse. She saved my life several times because she didn't run away when I fell from the saddle."

An enduring legend says saber-wielding Cossacks attacked German tanks. "Propaganda!" Vasily snorted. "Our main role was reconnaissance, ahead of the army. Sometimes we rode as much as 70 miles in seven hours."

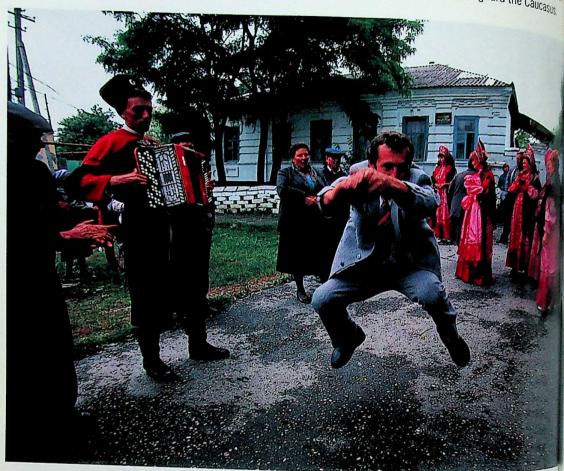
Mongolka bore Vasily for more than a year, until she was shot in a skirmish. Gunfire from a plane killed his second horse. Then Vasily fell wounded as he tried to prevent the Germans from blowing up a bridge. He recovered and kept on riding, through Romania, Hungary, and into Austria. When the war ended in 1945, he rode back to the Don on his sixth mount, having survived a classic Cossack experience, making war on horseback.

oday the Russian Army has begun to re-create all-Cossack units but has little need of horsemen; the only cavalry units are ceremonial. Still, I met several Cossacks who carried a *nagaika*, a cavalry whip like those their grandfathers used.

Igor Zvinyatskovsky had one tucked into his boot. In the courtyard of Moscow's Danilov Monastery, his uniform stood out among the bearded monks and shawled women making pilgrimages to this seven-century-old shrine.

"The police don't do anything to protect the monastery," Igor said, echoing the popular view of law enforcement as lax to nonexistent. But, as Igor explained, ardent devotion

Catching the spirit, an onlooker tries the Cossacks' tendon-stretching, squater and-kick Kazachok dance at a festival in Moskovskoye, part of the Azov-Mozachose line manned by Cossacks in the 18th century to guard the Caucasus



to the Russian Orthodox Church was once a tradition among most Cossacks. So, as Cossack bands revived, volunteers began to patrol within the monastery's walls to safeguard its priceless icons and prevent rowdiness. Today the church pays its Cossack guards.

Igor drew his four-foot-long nagaika from his boot. "It helps a lot when we catch a thief," he said. I asked if he had actually used it against a thief. He answered obliquely but knowingly: "He won't come back."

Cossacks with whips are sometimes seen in the throngs that attend Easter services; they believe their presence assures appropriate reverence. They assist the police at highway checkpoints or augment the border patrol. A police official told me Cossacks have occasionally lashed food vendors for price gouging.

Some Russians laugh contemptuously at these "play soldiers," as I heard one man call them. Others are uneasy. "We don't like to see them going about with their whips," a Muslim said. "It's threatening." Since the slaughter of thousands of Jews in Ukraine in 1648, Jewish families have handed down stories of Cossacks throwing infants into wells and ripping open pregnant women with swords. Cossacks also participated in pogroms in the 19th and early 20th centuries. Today Cossacks claim they are not anti-Semitic; still, things are said in passing. One leader, for instance, told me that Jews should not have positions of power in the government or the press beyond their small percentage of the population.

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Many Russians applaud Cossack vigilantism, hoping it will stanch the lawlessness that has flourished since the Soviet Union collapsed in 1991. At least a few Cossacks, along with other Russians, believe that their nation's manifold problems—economic disorder as well as lawlessness—could be solved if Russia was ruled again by a strong tear. Could that happen? "God will bring a new tear to us," one Cossack assured me.

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strong tsarina, Catherine the Great, sent large numbers of Cossacks south to the Kuban River in the late 1700s.* As she expanded Russia into the Caucasus region, Cossacks manned forts on the river's banks and homesteaded land belonging to Caucasus peoples. War was inevitable.

One day by the river I viewed a small shrine, fashioned like a steeple with a cross atop. A plaque named 17 Cossacks slain in an attack on their settlement in 1829.

The shrine is new; Soviet bosses destroyed the original monument about 65 years ago and replaced it with a dance pavilion. When Cossacks were free to reorganize after the Soviet collapse, the pavilion was demolished and the monument rebuilt. Surely there are no people in Russia more stubborn.

The Kuban region's capital is Krasnodar, or "gift of the Reds." In pre-Soviet days it was Ekaterinodar, "Catherine's gift." I walked among buildings with turrets and other trappings of the era that Russians call Victoriansky—Victorian—for this was a thriving trade crossroads in the 19th century.

Vladimir Gromov, a former history profes-^{§Or,} presides there as ataman of a voisko ^{that claims} 140,000 members. It may be the strongest in Russia and has become a force in local politics; Gromov and seven other Cos-^{Sacks} sit in the elected Kuban legislature. It has founded a cadet school and businesses.

"And every year we send more than a thou-Sand men to the army and the border patrol," he added. (Cossacks do not seem to yearn for their sons to have careers in such fields as medicine or computers. "They know they are

^a warrior people," as one woman told me.) I spent a couple of days with Kuban Cossacks in the small city of Lazarevskoye, beside the Black Sea. They run a huge market that yields \$85,000 a year from rentals to vendors of vegetables, clothes, and sundries.

The profit has helped create a new stanitsa. The city gave us this land," Ataman Valery Gololobov said as we walked on a hill above the sun-speckled sea. He wore army fatigues

See "Catherine the Great," by Erla Zwingle, NATIONAL GEOGRAPHIC, September 1998.

and a chain with a crucifix. Several houses were under construction; 43 are planned. The Cossacks who will live here, he emphasized, must promise to abide by strict rules.

"Why?" I asked. Stupid question.

"Order!" Valery boomed. "Order has to come back to our lives! It used to be you could walk at night and nobody would bother you. Now you'll be stripped of everything. Kids are taking drugs, abusing alcohol. We don't want this—the Russian Army needs strong men."

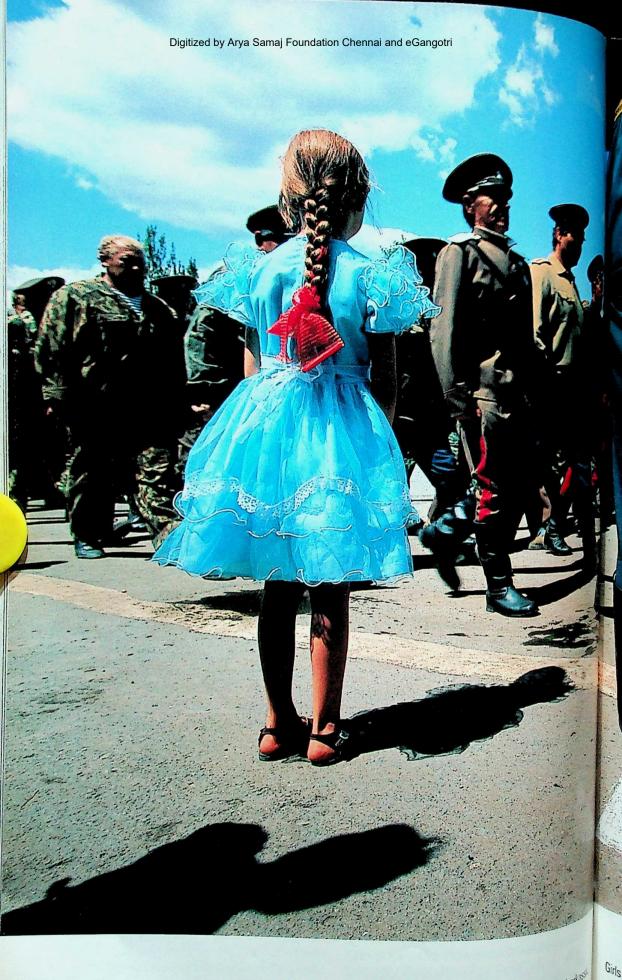
Order means no arguments with the neighbors, Valery added. Violators will be punished with the whip-five strokes for public drunkenness or wife beating, for example. In a nearby stanitsa a Cossack lieutenant received ten lashes for stealing Cossack funds.

"After being whipped, the man is supposed to bow and thank the elders for the 'knowledge' he has received," one ataman said.

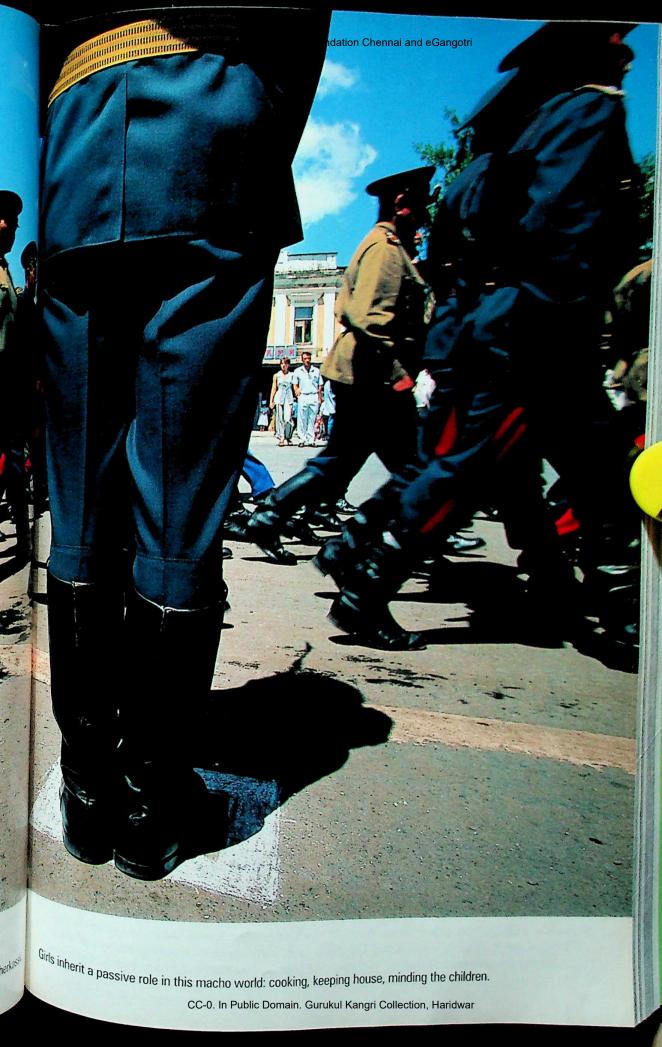
Among Lazarevskoye Cossacks, fealty to the Russian Orthodox Church is fundamental. When I asked if I could become a Cossack, one responded, "How do you cross yourself?" On purpose, I crossed myself the Russian way, right to left. "That's good!" he exclaimed. But when I confessed that in my church the accepted way is left to right, it became clear that no Episcopalians need apply here.

These Cossacks don't know their history. There were, and are, Cossacks of other faiths. A few Muslim Cossacks live in south-central Russia. There are even Buddhist Cossacks west of the Caspian Sea-the Kalmyks, who migrated from Mongolia in the 1500s. They, too, rode to Paris in the war with Napoleon, some bringing back French women.

n overnight train took me to Vladikavkaz, capital of the state of North Ossetia. When we pulled in, the sun was torching snow-mantled Caucasus peaks in the distance. Built in 1783, as Russia continued to expand southward, Vladikavkaz, literally "ruler of the Caucasus," was one of a line of forts along the Terek River, which loops through North Ossetia and neighboring Chechnya. "To rule the Caucasus" also meant to die. Chechens and other Caucasus peoples fought

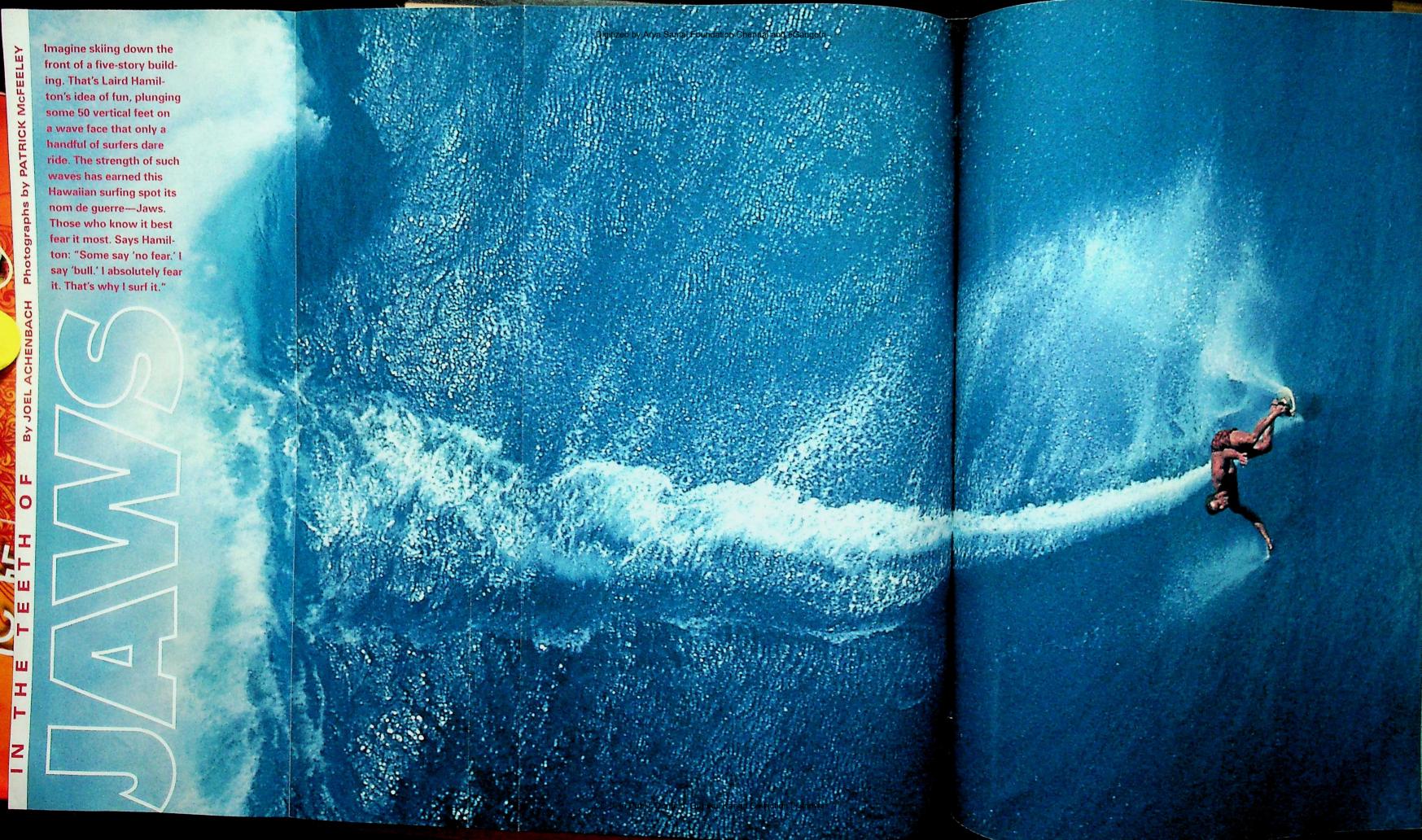


A PRETTY PATEH-O. For BLUTE Stands. வர்வுகங்கூரியில் Application வில்லாக parade in Novochestass









Digitized by Arya Samaj Foundation Chennai and eGangotri

ORMAL WAVES are, by comparison, mere ripples. The waves at the almost exaggeration process Jaws are so large as to be almost exaggeration-proof. In fact Jaws are so large as the load here. Mountainous? Too in large "doesn't quite carry the load here. Mountainous? You a word to describe a heaving fluid. Voluminous? You could say the same thing about a duck pond. Titanic? No, too much cultural baggage. Let's just say these are "very big" waves.

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The surfers have their own vocabulary, needless to say. They describe these waves as "heavy" or "gnarly" or "radical," all of which means they are ... well

very big.

Surfers are still talking about January 28, 1998, Big Wednesday, when storm-spawned swells created waves so large that Honolulu's Ocean Safety Administrator declared Waimea Bay on Oahu legally off-limits. There was no safe place to surf. But Jaws is the creation of a peculiar reef, a spur that sticks out from Maui into the ocean with a deepwater channel along one side, allowing surfers to ride waves as intimidating as tsunamis.

Estimates vary, but a small wave at Jaws has a 20-foot face, and surfers talk about 60- and 70-foot faces. They talk about waves with barrels so huge you could park a Winnebago in them. They talk about the violence of a wave's lip as it crashes into the impact zone. They say, "That lip could snap your neck

like a chicken bone." In other words, they respect Jaws.

"Jaws is one of the heaviest, if not the heaviest, wave around," says surfer Pete Cabrinha. "What makes Jaws different is that when the wind's not on it, it's a perfect wave because of the way it breaks. It's a long, peeling wave, which is unusual for a big-wave spot. It breaks at one point and keeps breaking uniformly as it goes down the line."

Not that Cabrinha ponders such things in the rush of the moment. No surfer at Jaws spends a lot of time intellectualizing the situation. (What do you think they are, crazy?) The main thought is: Make it. Make the wave

Don't get gobbled.

Everything happens at a furious pace. A wave this big doesn't have a singular, smooth face. The face is sculpted by surface chops that can bounce a surfer into the air. There are waves upon waves. "It's like you're skiing on a mountain that changes every second as you're going down—moguls pop up in front of you and disappear," says surfer Laird Hamilton.

Of course they have to show some moves—bottom turns, cutbacks aerials. They put on a show for their buddies and for the omnipresent cameras. (Often photographers buzz just overhead in a helicopter.) Surfers say there's a moment of pure existence on the wave—no past or future, just the pulse pour 1: the pulse-pounding present. "There are no opinions in big waves," says Hamilton. "You either make it or you don't make it."

Hamilton remembers the time he barely avoided getting smashed by the curling lip of Jaws. The initial impact missed him, but the secondary explosion of white water wiped him out. "It just vaporized me. I felt like my body went into little particles."

Dave Kalama also knows the sensation of being "rag dolled" in the water. "It's like four Arnold Schwarzeneggers,



JOEL ACHENBACH is a reporter for the Washington Post and the author of Why Thing First-time contributor PATRICK McFeeley specializes in aerial and action Photographics book Jaws Maui features in acres in aerial and action photographics in aerial action photographics are action at a constant action a His book Jaws Maui features images of some of the largest waves ever surfed.

Digitized by Arya Samaj Foundation Chennai and eGangotri

one on each appendage, are shaking you. You're doing cartwheels and flips and somersaults all at the same time."

when people refer to Jaws, they are sometimes talking about geography, distinguishing the site from other big-wave locations in Hawaii. But they also use the word to refer to the waves themselves. Jaws isn't just a location, it's a theoretical wave that manifests itself in real life. It's almost a spiritual entity, asleeping giant that sometimes awakens and beckons surfers.

What's astonishing is that on a typical day there's no sign of Jaws. You drive through a pineapple plantation and come to the cliff overlooking Jaws and see...nothing. There's just blue water. A fisherman anchored on the spot one night, unaware that there was a reef below capable of generating a ravenous wave. His boat got eaten up. Or so the story goes.

A ride on Jaws lasts less than half a minute, but the whole process leading up to it takes close to 24 hours. Pete Cabrinha begins by surfing the Internet. Cabrinha and his wife, Lisa, live about three miles from the ocean, and he keeps a speedy computer alongside his surfing magazines and drum kit.

Cabrinha starts by looking at images of the northern Pacific posted on a University of Hawaii website. He wants to see storms drifting from the coast of Japan toward the Aleutian Islands. Winds from these storms generate swells that break days later at Jaws.

Cabrinha pays close attention to what's called the fetch of the wind—the distance the wind blows in a consistent direction. The longer the fetch, the bigger the swells. (In 1933 a vast weather disturbance off Russia's Kamchatka Peninsula stirred up winds with a fetch several thousand miles long. A wave estimated at 112 feet nearly swamped the Navy tanker U.S.S. Ramapo.)

Another website details the measurements of waves passing a National Weather Service buoy 390 miles northwest of Maui. Cabrinha wants to see double-digit numbers: 10-foot waves are interesting; 15- or 20-foot waves are compelling. He also looks at the wave period—the interval between crests hitting the buoy. Waves far apart have deeper "roots" of energy and are more likely to break at Jaws' deep reef. It takes about 12 hours for waves at the buoy to reach Maui-plenty of time to check equipment, re-check equipment, pace, anticipate, obsess, and fail to get enough sleep.

The biggest danger for surfers isn't being crushed or snapped in two—it's drowning. They have to train themselves not to panic underwater, even when they can't tell which way is up. A wave like Jaws has such a thick foam layer in the impact zone that for paralyzing seconds it's impossible to swim to the surface. The foam also blocks out

the sun, so tumbling surfers are disoriented and nearly blind. When they finally get their heads above water after a wipeout, surfers look for one of their buddies to charge to the rescue on a Wave Runner. Another giant wave will come crashing down in seconds. If the rescuer doesn't make it in time, they have to go through the foamy violence all Over again. The only losses so far: one Wave Runner, a couple of boards,

and some windsurfing rigs. When surfers make it to the calm channel, they get towed back out to sea. They don't stop until they run out of gas. Then everyone goes to a joint called Charles the called Charles and the called Charles are the called Charles and the called Charles are the called Charles ar called Charley's to eat breakfast and replay the highlights.

"You're shell-shocked," says surfer Mark Angulo. It's like being a gladiator," says Hamilton.

"We're walking on the moon," says Cabrinha. Then, like astronauts, they have to resume their terrestrial lives. And wait for Jaws to roar again.

THE TEETH OF JAWS CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar

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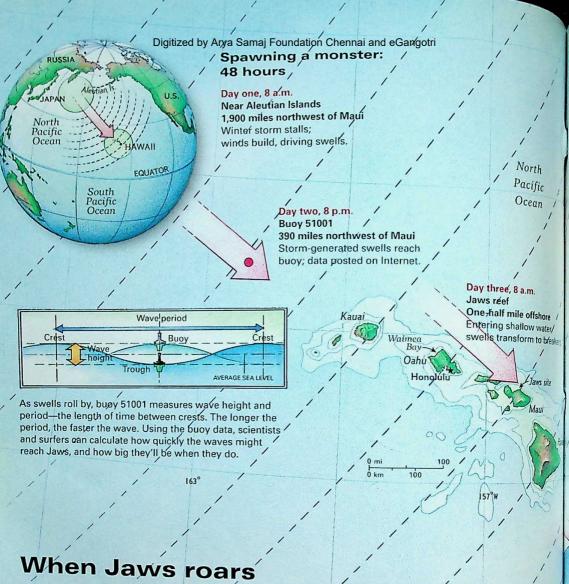
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Digitized by Arya Samaj Foundation Chennai and eGangotri Cutting his losses, Robby Naish (above) launches himself from the curling lip of Jaws' cavernous ^maw and the deadly force ^{of his} nearly 30-pound board and sail. Another Wave swallows Lyon Hamilton whole, spitting his board (right) at a photographer's hovering helicopter and leaving ^{roughly} 20 seconds for him to be rescued before the next wave sweeps in.



Local surfers also call Jaws by its native name, Peahi, Hawaiian for "beckon." And that's just what it does. "You can hear it from miles away," says Laird Hamilton of the spot's siren song-the thunder of giant waves pummeling a normally placid shoreline.

Jaws generates a breaking wave only when ocean swells reach a certain size. From the north shore of Maui a massive underwater ridge—the remnant of an old lava flow—juts straight out to sea. "It's impressive in its size and its steepness. It's huge," says former champion surfer Rick Grigg, now a professor of oceanography at the University of Hawaii.

A little over half a mile from shore the reef drops abruptly away into the sea. An average swell of 10 to 12 feet passes over the nub of the reef without incident. But larger swells, storm spawned, suddenly mound upward as they strike the reef, a process called shoaling.

Jaws has a second wave-rearing trick. The swells on either side of the reef, moving in deeper water, bend inward, focusing much of their energy on the center of the wave crest. This refraction of wave energy is like a magnifying glass gathering light into a hot, focused beam. In essence, the reef squeezes the wave inward and upward. Surfers call it a peaking wave. It's a pyramid of water worthy of a pharaoh.

The deepwater channel next to the under water ridge also ensures that there is a safe zone where the wave won't break. That's where surfers are headed when they're flying down the face of Jaws.

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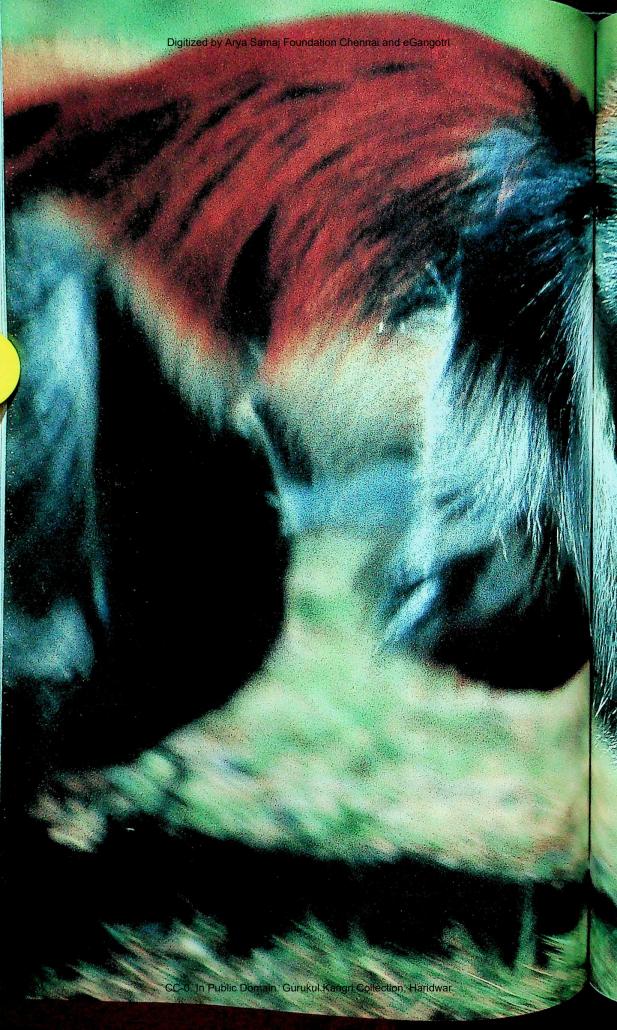
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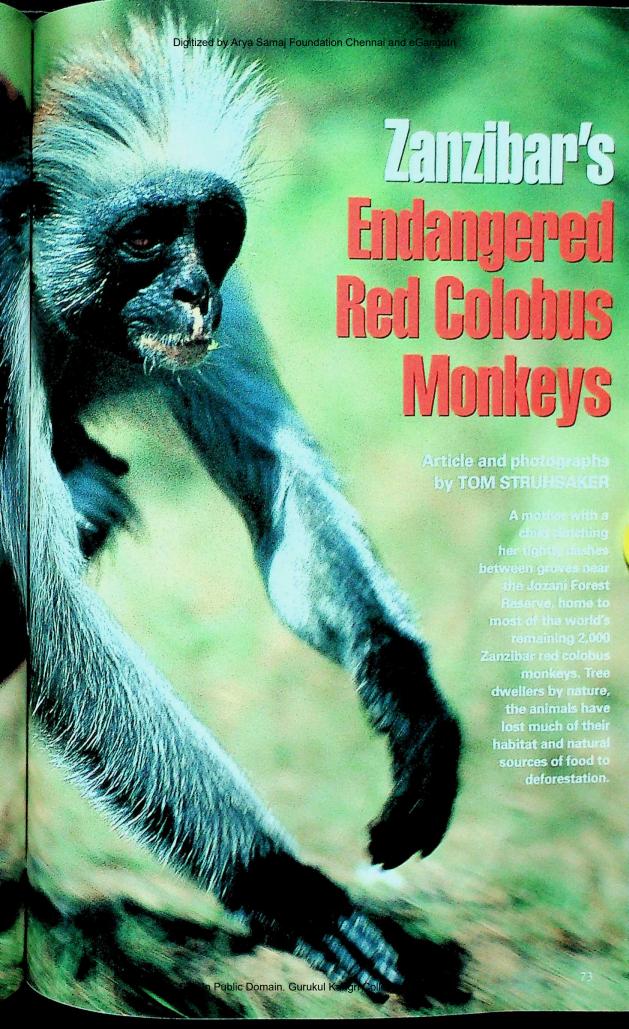
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Mike Waltze can heigitized by Arya Samaj Foundation Chennai and eGangotri Jaws' thunderous roar as it chases him toward the shore. With the collapsing wave at his back, he forces himself to focus on what lies ahead—relative safety in the channel that hugs Maui's reef. "It's the avalanche theory," Waltze says. "Keep going until you're out of its path." Then ride it again? "Every chance." For more on surfing join our forum at www.nationalgeo graphic.com/media/ngm/9811. CC-0. In Public Domain. Gurukul Kangri C







linging to childhood, male *Procolobus kirkii* nurse far longer than do infants of most other species of red colobus, which live on the African mainland. Some males (below) suckle until they are three or four years old and ready to breed.

RESEARCH PROJECT

Supported in part by your Society

Female infants nurse for up to a year and a half.

A two-week-old

baby (opposite) clings to its mother for protection. The long nursing period may cause hormonal changes in the mothers that delay future pregnancies. Zanzibar red colobus mothers average about three and a half years between births, nearly twice the interval for mainland

Duke University biologist Tom STRUHSAKER has studied red colobus monkeys since 1969.



species. This low reproductive rate is one factor in the monkeys' clouded future.

Zanzibar encompasses just 640 square miles, and its human population will double, at current rates, within

the next 20 years. The red colobus are, quite literally, being crowded out. At one time Zanzibar was covered with extensive forest, a perfect habitat. But as humans cut down trees for farming, construction, and fuel, the forest has not been able to recover. Now the monkeys, which once roamed most of the island, are concentrated in the vicinity of Jozani Forest Reserve. There they survive in forest, mangrove swamps, and private gardens with mango, coconut, and other fruit trees. Forced by habitat loss to spend more time on the ground. the monkeys fall victim to careless drivers.

The animals live in groups of about 30, with up to six males in each group. Often groups will split up, then reunite at a later time, a social system uncommon among primates.





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howing down on charcoal (opposite), a red colobus partakes of the species' most unusual dietary supplement, one that may allow the monkeys to eat potentially harmful foods. With their four-chambered stomachs they can easily digest the cellulose in leaves,

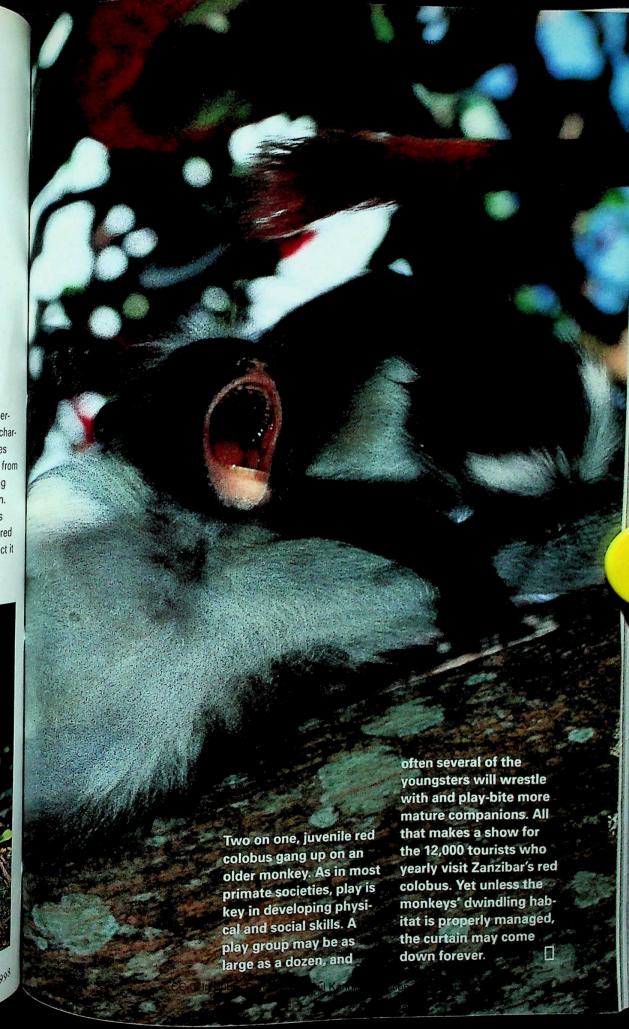
as well as the fruit of Mkwamba shrubs (above).

In some areas of the island they also eat the leaves of mango and Indian almond, two tree species introduced by humans. Both types of leaves contain generous amounts of protein—but also high levels of phenolics,

which can be toxic or interfere with digestion. The charcoal apparently eliminates the damaging chemicals from their system while leaving the protein for absorption.

Groups of the monkeys gnaw charcoal from charred stumps (below) and collect it from charcoal kilns.





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THE ENDURANCE

In 1915 on a frozen sea Anglo-Irish explorer Ernest Shackleton (right) lost his ship and his dream of crossing Antarctica on foot. What began as a journey of exploration became a 20-month battle to stay alive, demanding ingenuity, courage, and leadership. All these Shackleton held in full measure.

EPIC OF SURVIVAL

SHACKLETON

BY CAROLINE ALEXANDER PHOTOGRAPHS BY FRANK HURLEY

TT IS ONE of the very greatest survival stories in the annals ▲ of exploration. Sir Ernest Shackleton, his ship Endurance crushed by ice in Antarctica's Weddell Sea, led his men to safety through a series of impossible journeys over land and sea that, more than 80 years later, still leaves one gasping. When I was reading South, Shackleton's account of his adventure, I stood one evening in New York City, at a 79th Street bus stop, with the book tucked under my arm. Feeling an insistent

lug on my sleeve, I turned to meet the gaze of a man who was staring at me with the burning eyes of a zealot.

"Shackleton," he said, in half-whispered complicity, knowing that if I had read even Part of the book, I would be a convert.

The Imperial Trans-Antarctic Expedition Imperial Trans-Antarcue Lap-left plymouth, England, on August 8, 1914, just at the outbreak of the First World War. Shackleton's ship was a three-masted wooden sailing vessel—a barkentine—specially designed to wither withstand ice. Called *Polaris*, the ship had been built be a control of the cont built by Norway's most renowned shipyard out of oak, Norwegian fir, and greenheart, a wood



so dense that it has to be worked with special tools. Shackleton renamed her the Endurance, after his family motto, "Fortitudine vincimus-By endurance we conquer."

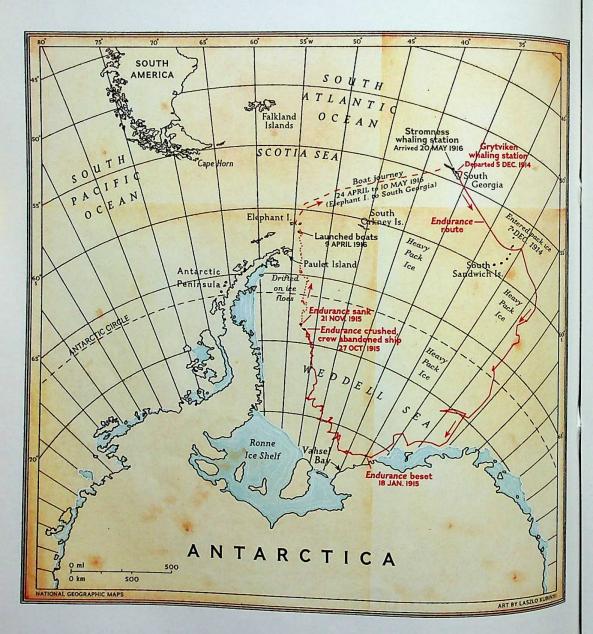
Heading south, expedition's last port of call was the island of South Georgia, a wild subantarctic outpost of the British Empire inhabited by a small community of Norwegian whalers. From here the Endurance set sail for the Weddell Sea, the dangerous ice-infested ocean abutting the Antarctic continent. Battling

her way through one thousand miles of pack ice over a six-week period, the Endurance was about a hundred miles from her destinationone day's sail away-when on January 18, 1915, the ice closed in around her. A drastic drop in temperature caused the seawater to freeze, effectively cementing the compressed ice. The Endurance was trapped, "frozen," as the ship's storekeeper wrote, "like an almond in a piece of toffee."

Shackleton was by this time already a famous polar explorer. He had first been south with Capt. Robert Falcon Scott in 1901, drawn to Antarctica by the ideal of heroic quest.

CAROLINE ALEXANDER has written two books about Shackleton's journey—Endurance: Shackleton's Legendary Hunger Expedition. Shackleton's photographer, Frank Line Expedition. Shackleton's He died in 1962. Antarctic Expedition, due out this month, and Mrs. Chippy's Last Expedition. Shackleton's photographer, Frank Hurley, kept his to the out this month, and Mrs. Chippy's Last Expedition. Hurstic Expedition, due out this month, and Mrs. Chippy's Last Expedition. Shackleton's photographic filler, kept his taste for adventure, shooting in Papua New Guinea and other exotic locales. He died in 1962.

"One might as well try to cross from Ostend to Dover on water lily leaves as get over the pack from where we are now."



After leaving South Georgia, the Endurance became beset in pack ice a hundred miles from her destination, Vahsel Bay. For nine months the sea dragged her farther from the continent. In February the crew played soccer on the ice (right) with their ship still intact. But by November she had been crushed, and the men were forced to live on the drifting floes. Finally, by pulling their three lifeboats on sledges, they reached open water in April 1916 and sailed to Elephant Island. From this barren spot Shackleton and five men sailed on a desperate voyage back to South Georgia for help.

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But the expedition ended in failure for Shackleton when he was invalided home with scurvy after the first winter. Five years later, at the head of his own expedition, he won renown for marching to within one hundred miles of the South Pole, the farthest south anyone had been. In December 1911 Roald Amundsen claimed the South Pole for Norway, leaving only one prize remaining in polar exploration—the crossing on foot of the Antarctic continent. It was on this Shackleton had set his sights.

ow, WITH THE ENTRAPMENT in the ice, his most daring venture was thwarted. More important, he was responsible for the care of 27 men—as well as 60 sledging dogs, two pigs, and the ship's cat, Mrs. Chippy. For the next ten months the *Endurance* zigzagged more than a thousand miles with the northwest drift of the pack. As each day passed, Shackleton and his crew knew that the Antarctic continent was falling farther and farther away.

Some of the men were professional sailors from the Royal Navy; some were rough trawler hands who had worked in the brutal cold of the North Atlantic; some were recent graduates of Cambridge University who had come along as scientists. One, the youngest man on board, Perce Blackborow, had stowed away in Buenos Aires. All had come with different hopes, which had now evaporated.

For Shackleton, the disappointment was particularly bitter. He was 40 years old, and the expedition had taken considerable energy to

prepare. Europe was consumed by war, and he was unlikely to have this opportunity again. Nonetheless, he knew that his men would look to "the Boss," as they called him, for direction and morale. Disguising his emotions, Shackleton gave the appearance of being confident and relaxed, and the long months on the *Endurance* passed almost enjoyably.

All hands on board knew that one of two things would eventually happen: Come spring, the pack would thaw and disperse, freeing them. Or, the pressure exerted by the grinding floes would take hold of the little ship and crush her like an eggshell. In October 1915 the signs were ominous.

In his diary, now in the State Library of New South Wales, Australia, Frank Hurley, expedition photographer, wrote on October 26: "At 6 p.m., the pressure develops an irresistible energy. The ship groans and quivers, windows splinter, whilst the deck timbers gape and twist. Amid these profound and overwhelming forces, we are the absolute embodiment of helpless futility. This frightful strain is observed to bend the entire hull some 10 inches along its length."

On the following day, Shackleton gave the order to abandon ship. The men spent their first night on the ice in linen tents so thin the moon shone through them. The temperature was minus 16° Fahrenheit.

"A terrible night," wrote expedition physicist Reginald James in his diary, "with the ship sullen dark against the sky & the noise of the pressure against her . . . seeming like the cries of a living creature." (Continued on page 90)

Digitized by Arya Samaj Foundation Chennal and eGangotri E. Holmess Mm Bakewell Blackborow Af Sters FA. Worsley Mmenish. E. A. Shank George & Marstan of Orde Loes L. D. a. Heracy A Whames In September 1915 Frank Hurley photographed Shackleton, front row, third from left, with his crew, who signed their names in Hurley's album, Shackleton, front row, third from left, with his crew, and the state of on th who signed their names in Hurley's album. Shackleton, front row, third from left, with his from some 5,000 applicands, inclinding Physique Gurukul Kangri Collection, Hardwar the Antarctic expedition with who were summarily rejected. Of the 27 men and in "

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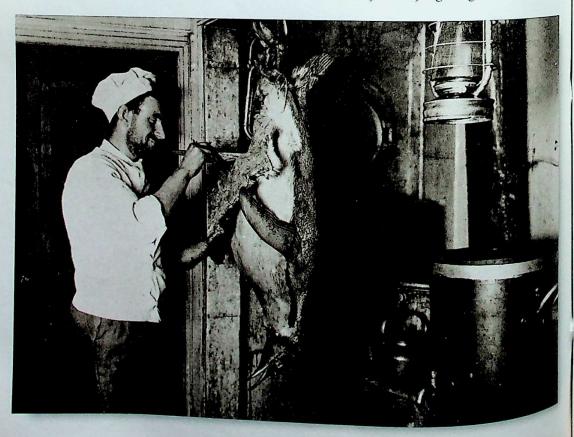
on the Endurance, Shackleton knew five from previous polar journeys, acquired one as a stowaway, and chose the rest on little more than hunches. But he chose well. He later wrote that his crew, even in "dark days and . . . continuous danger, kept Christian the chose well."



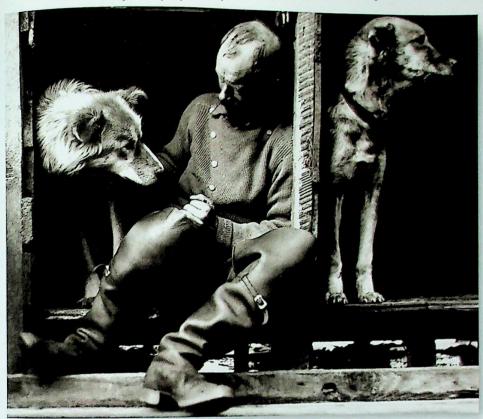


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In black and white and Paget, an early color process, Hurley chronicled the expedition's small stories before its epic disasters. Stowaway Perce Blackborow (above left) proved useful and brave. Boatswain John Vincent (above center) was demoted for bullying. Dog lover Frank



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Wild (above) was Shackleton's loyal second-in-command. To vary their diet and ward off debilitating scurvy, the cook prepared nutritious penguin (below left). To break up the long polar night, Wild started a flurry of haircuts (below) in what Hurley called "mid-winter madness."



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For two days in February 1915 the crew chopped a channel for the Endurance in hopes of reaching open water. But they gave up 400 yards short of the lead, thwarted by layered ice up to 18 feet thick.

Most of the expedition's food supplies were still trapped in the *Endurance*. Their warmest clothes were their long woolen underwear and Burberry windbreakers, about the weight of umbrella fabric. They had no radio communication, and no one in the world knew where they were. To get to safety once the ice broke up, they had only three salvaged lifeboats—and Shackleton to lead them.

"I can't remember the matter being discussed or argued in any way," James would recall. "We were in a mess, and the Boss was the man who could get us out."

a venerable institution that has sponsored innumerable expeditions of discovery, the archivist brought me a Bible. I turned to the 38th chapter of the Book of Job—or, more accurately, to where the 38th chapter of Job once was. The page, as I already knew, was missing.

The day after the abandonment of the *Endurance*, Shackleton gathered his men and quietly told them they were going to try to march over the ice to Paulet Island, nearly 400 miles to the northwest. Only the barest essentials could be carried, and personal gear had to be sacrificed. By way of example, Shackleton took the ship's Bible and, ripping out a page from Job, deposited the book on the ice. The verses he saved read:

Out of whose womb came the ice? And the hoary frost of Heaven, who hath gendered it? The waters are hid as with a stone, And the face of the deep is frozen.

It was a dramatic gesture. What Shackleton never learned was that one of the sailors, a superstitious old salt named Tom McLeod, secretly carried the Bible away, believing that leaving it would invite bad luck.

The march to land was reluctantly abandoned: Dragging the loaded boats, each of which weighed at least a ton, over the colossal fragments of pressure ice and through deep snow proved impossible. The expedition now regrouped, and Shackleton determined there was nothing to do but pitch camp on the drifting ice and see where the current and winds would take them before conditions permitted the use of the boats.

Ocean Camp—the first of two camps pitched on the ice—was their new home. An eccentric supply of food was salvaged from the half sunk *Endurance*; the crates that first floated to the surface—soda carbonate, walnuts, onions—were not necessarily what the men would have chosen for starvation rations. Sledging rations originally intended for the transcontinental trek were put aside for use in the boats.

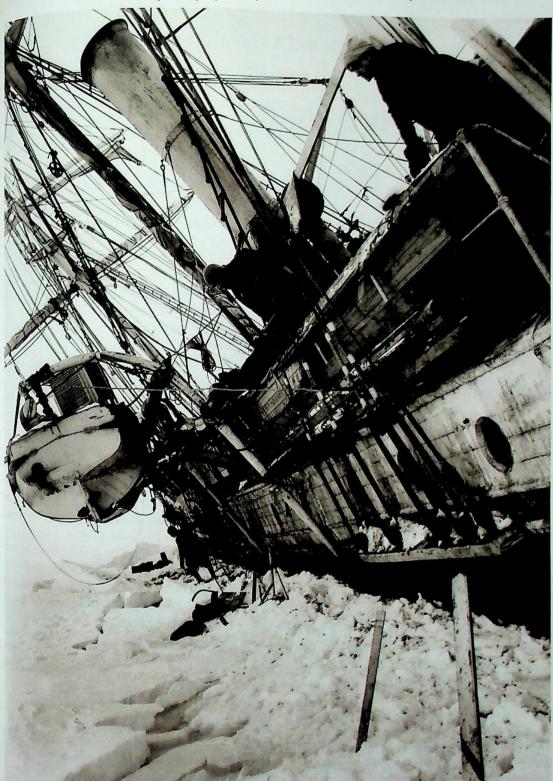
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It was now summer in the Southern Henrisphere, and temperatures crept as high as 33° f.



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PREPARING TO ABANDON SHIP

Nine months later Shackleton, top right, watched as the massive ice floes tightened their grip. Endurance lurched 30 degrees to port, causing an avalanche of stores, sledges, dogs, and men. The pressure eased but returned to squeeze and splinter the ship until ice alone held her afloat. After a ten-day battle Shackleton surrendered. "She's going, boys," he said. "I think it's time to get off."

"A terrible night with the ship sullen dark against the sky & the noise of the pressure against her...seeming like the cries of a living creature."

The soft slush of snow made walking difficult, and the men's clothing was always wet; then the temperatures dropped each night, freezing the sodden tents and clothes. The principal diet was penguin and seal, and seal blubber provided the only fuel.

The men spent most of their time analyzing the direction of the ice drift. Their greatest hope was that the drift would continue north by northwest, carrying them within striking distance of Paulet Island, off the tip of the Antarctic Peninsula, where there was a hut with supplies from an earlier Swedish expedition. Shackleton's prime concern was not food or shelter but morale, and he feared the advent of depression as much as scurvy, the traditional bane of polar expeditions. The latter could be prevented by eating the organs of freshly killed animals, but the former required more complex management.

"Optimism is true moral courage," Shackleton often said. His particular concern was for the sailors, who more than the other men had been devastated by the loss of the Endurance. As Shackleton acknowledged, "To a sailor his ship is more than a floating home." From his earliest days as an explorer Shackleton had mixed easily with both the lower deck and the officers, and this now paid off. He was also well tuned to the temperaments of his men and catered to each. Hurley was somewhat vain, and Shackleton flattered him by making a pretense of consulting him privately on all matters of importance. A man found complaining that "he wished he were dead" was curtly assigned galley duties to distract him. Two of the more solitary and vulnerable men of the company were taken into Shackleton's own tent.

Other tactics were more controversial. The scientists and other educated personnel believed that the gravest danger facing the party was lack of food, and they wanted to kill and stockpile any wildlife that came their way. For the sailors who had been quartered in the

fo'c'sle, on the other hand, the greatest imaginable hardship was remaining long months on the ice before being able to take to the boats. When Lionel Greenstreet, the first officer, urged Shackleton to put by more meat, Shackleton's response was instructive.

"Oh," he said. "You're a bloody pessimist. That would put the wind up the fo'c'sle crowd, they'd think we were never going to get out."

In mid-January four teams of sledging dogs were shot; the ice had become too treacherous for them to be safely used, and meat for their food was in increasingly short supply.

"This duty fell upon me & was the worst job I ever had in my life," reported Shackleton's loyal second-in-command, Frank Wild, in his memoir, also in the State Library of New South Wales. "I have known many men I would rather shoot than the worst of the dogs."

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By March the northerly drift of the pack had carried them abreast of Paulet Island—but far to the east of it.

"One might as well try to cross from Ostend to Dover on water lily leaves as get over the pack from where we are now," wrote Thomas Orde Lees, the expedition's storekeeper. "What is going to happen remains to be seen."

March was bleak. The last of the dogs were shot—and this time eaten. The men lay in the tents, huddled in their bags that had frozen as stiff as sheet iron, too cold to read or play cards.

N APRIL the ice cracked through their camp, and Shackleton knew that the long-awaited breakup was at hand. On April 9 he gave the order to launch the three boats, the James Caird, the Dudley Docker, and—barely seaworthy—the Stancomb Wills, all named after sponsors of the expedition. Twenty-eight men crammed aboard them with their basic camping gear and rations. The temperature dropped to minus 10°F, and high seas poured over the open boats and men, who had no waterproof clothing.



On a final trip back to the Endurance, Wild watched the ship in what surgeon Alexander Macklin called her "death agony." A week later she slipped under the ice, which quickly closed over her. One man wrote, "Without her our destitution seemed more emphasized, our desolation more complete."

Day and night, through the minefield of grinding ice, then through the crashing waves of the open sea, the helmsman of each boat tried to hold his course, while his shipmates bailed. The boats were too small to maneuver in gale force winds, and after several changes of direction, Shackleton gave the order to run due north, with the wind behind them, for a splinter of land called Elephant Island.

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This boat journey was made most vivid to me by a trip I took on a fine, calm winter day—not to the Antarctic but to East Anglia, England. The son of Huberht Hudson, navigator of the Endurance, had agreed to let me see the sextant his father had once steered by. Serene in its packing case, its brass somewhat faded, it was an evocative relic—but not as evocative as the single image Dr. Hudson recalled of his father.

"My father's fingers were bent, you see," he said quietly, contorting his own hands. "From the frostbite."

For seven sleepless, nightmarish days and terrifying black nights, the men endured cold that froze their clothing into solid plates of

icy armor. Out of the night-dark sea, with explosive, rhythmic exhalations, white-throated killer whales rose beside the boats, taking the measure of the men with their small, knowing eyes. Ernest Holness, who had braved the North Atlantic on trawlers, covered his face with his hands and wept. Blackborow, the popular young stowaway whom Shackleton had made ship's steward, quietly mentioned that his "feet felt funny." And Hudson, bent over the tiller with ungloved hands, finally collapsed. Shackleton's exhaustion was extreme.

"Practically ever since we had first started Sir Ernest had been standing erect day and night on the stern counter of the *Caird*," wrote Orde Lees. Shackleton knew it was important to his men that they see him in charge.

At last, on April 15, the boats hove under the forbidding cliffs of Elephant Island, and a landing was made.

"Many were suffering from temporary aberration," was Hurley's description of his shipmates' mental state. Many lay on the ground burying their faces in the stones or reeled down

Shackleton knew that the outside world would never come to Elephant Island. There was only one remotely feasible course of action....

the small beach, laughing uproariously. It had been 497 days since they had last set foot on land, but, as they soon discovered, a more godforsaken, blizzard-raked part of the Earth could scarcely exist. Howling 80mile-an-hour winds off the glacial peaks shredded their tents and swept away precious remaining possessions-blankets, ground sheets, cooking utensils. The sailors crawled into the boats to take cover; others lay with the cold wet tent canvas collapsed about them, draped over their faces.

Shackleton knew that the outside world would never come to Elephant Island. There was only one remotely feasible course of action, and it was terrifying. He would take the largest lifeboat, the James Caird, and with a small crew sail 800 miles across some of the most dangerous water on the planet, the South Atlantic, in winter, to the whaling stations of South Georgia. They could expect to encounter waves as high as 50 feet from tip to trough, the notorious Cape Horn rollers. They would navigate by sextant and a chronometer whose accuracy was unknown, depending on sightings of the sun-but they knew that in these latitudes weeks of overcast weather could prevent a single sighting.

It is possible to make a pilgrimage to the boat itself, now retired in Shackleton's old school, Dulwich College, and one day I went there on a day trip from London. To conjure the scale of the seas that this unremarkable-looking wooden craft had survived was beyond both my experience and imagination, and standing beside the *Caird*, I was struck by a more banal consideration—that six men had found room in so small a craft. Overcome by unexpected emotion, I wept.

The James Caird was a 22¹/₂-foot-long wooden lifeboat, whose gunwales had been raised by the skill of Henry "Chippy" McNish, Shackleton's gifted Scottish carpenter. Working outside with frost-nipped hands as the blizzards raged on Elephant Island, McNish salvaged what timber he could from packing cases and old sledge runners. The "decking" was made of canvas, painfully thawed over

nails were secondhand, extracted from packing cases. In lieu of hemp and tar for caulking, Chippy used lamp wicks, seal blood, and the oil paints of the ship's artist. The ballast was two tons of rough

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with brittle needles. The

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Elephant Island beach stone. Shackleton chose five men whose seamanship and fortitude he felt he could trust; two of the men-McNish and John Vincent, a bullying sailor who had worked on trawlerswere also known to be "difficult" characters, and he wanted them on board under his watchful eye. His navigator would be Frank Worsley, a high-spirited, somewhat rambunctious New Zealander, whose talent for navigation under impossible conditions had already helped bring them safely to Elephant Island. Tim McCarthy was a cheerful young Irish sailor, well liked by the whole company. The sixth man, Tom Crean, was a powerful apparently indestructible Irishman who had sailed on both of Scott's expeditions; on the last he had been awarded the Albert Medal for bravery when he trekked 35 miles alone his through snow, supplied only with three biscuits and two pieces of chocolate, to bring help to a stricken companion.

The *Caird* set out on April 24, 1916, on a rare afternoon of relative calm. "Bravo! Bravo!

94



CARY WOLINSKY (OPPOSITE): ROYAL GEOGRAPHICAL SOCIETY

After five months on ice and nine days on wind-ravaged Elephant Island, Shackleton and five crew set off in search of rescue, their boat caulked with lamp wicks, seal blood, and oil paints. Trusting in an unfamiliar sextant (left), Frank Worsley steered for South Georgia—800 miles away.

leader," Orde Lees exclaimed in his diary, now in the National Library of New Zealand, as they left. The men Shackleton left behind faced their own trials, surviving on penguins and seals and living in a makeshift shelter under the two remaining overturned boats. Frank Wild, Shackleton's lieutenant, was in charge of the demoralized and shaken men, some of whom—Blackborow, Hudson, and Rickinson, the engineer, who had suffered a heart attack—were in grave need of medical attention.

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HE DAY AFTER departure the Caird's ordeal began in earnest. Of seventeen days sailing, there would be ten days of gales. Icy waves soused the men. Beneath the canvas decking, the off-duty watch lay for four hours on stone ballast in wet and Putrefying reindeer-skin sleeping bags; the dark space beneath the thwarts was so narrow that it gave the men the sensation of being buried alive. One night they awoke to find the boat staggering in the water. Ice as much as 15 inches thick encased every sodden inch of wood and sail. Despite the dangerous pitching and rolling of the boat, the men had to crawl onto the glassy decking and hack the ice away.

If Shackleton noticed that any one of the men seemed to be suffering more than usual, he ordered hot drinks prepared for all hands on their little Primus stove.

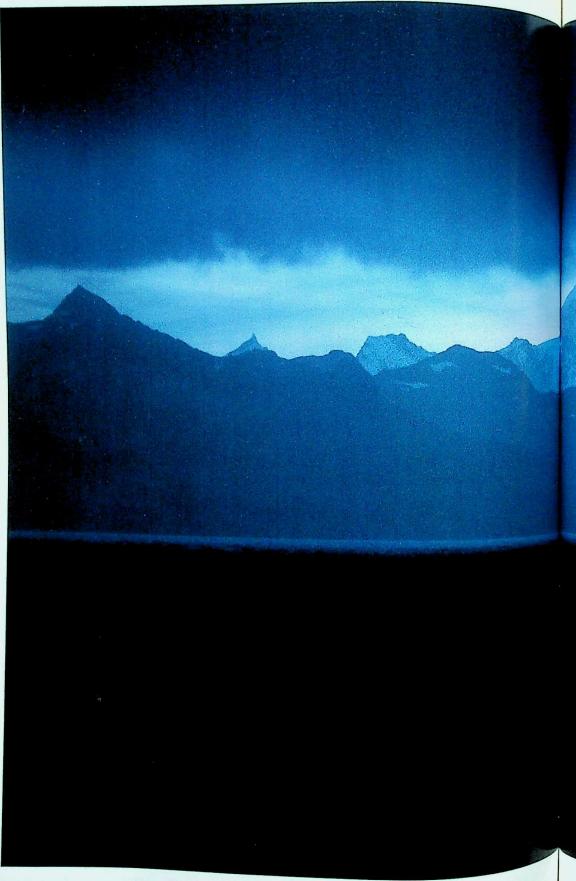
"He never let the man know that it was on his account," Worsley recorded, "lest he become nervous about himself." Despite Shackleton's care, Vincent collapsed after the first few days, and McNish was in a bad way, although still soldiering on. All six found that their feet, which were constantly wet, were white and swollen and had lost all surface feeling, while their bodies were cruelly chafed by their salt-ridden, icy clothes. Yet grimly, mechanically, through all the upheaval of wind and surf, they kept their watches, prepared their meals, took their turns at the makeshift pump, worked the sails, and held their course.

McCarthy shamed them all.

"[He] is the most irrepressable optimist I've ever met," Worsley scrawled in his navigating book. "When I relieve him at the helm, boat iced & seas pourg: down yr neck, he informs me with a happy grin 'It's a grand day, sir."

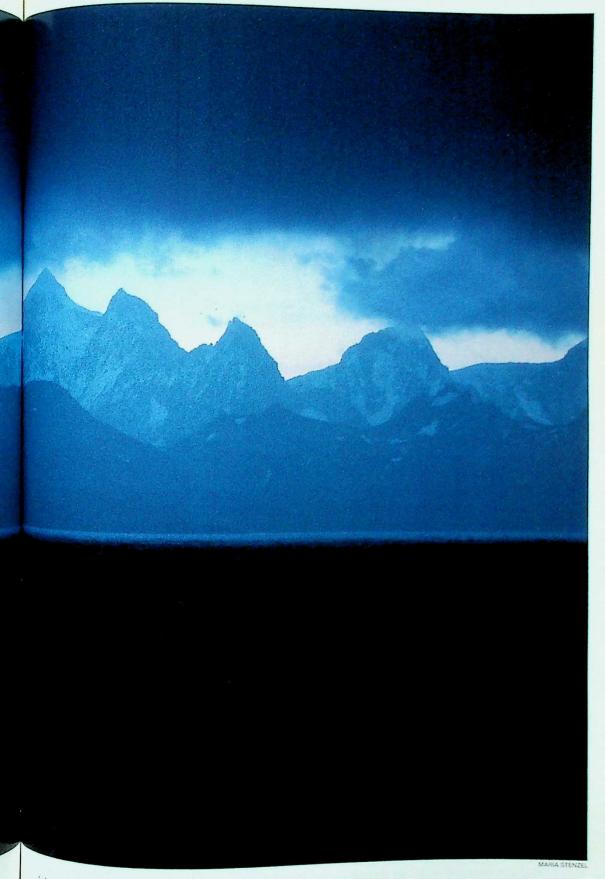
As feared, Worsley was able to take few sightings with the sextant he had borrowed from Hudson. Drawing on experience and an

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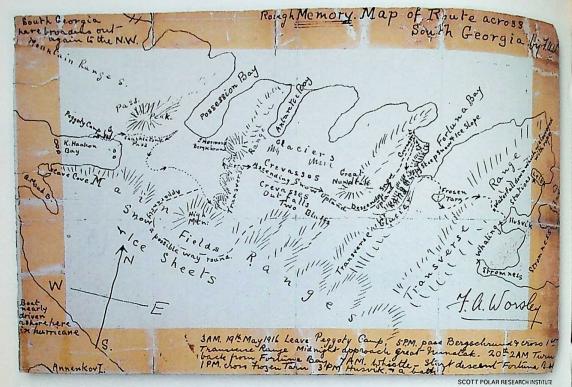


Salvation. Shackleton and crew rejoiced at the sight of South Georgia's jagged coast, having sailed for 17 days through gale-force winds on the dark and heaving Scotia Sea. They had lost their an chor; their sodden clothes had public pometry Guryky Kangri Collection, Harlowar had turned brackish. Had they missed the narrow

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island, the next landfall was Africa, nearly 4,000 miles away. They put ashore 150 miles by sea from their goal, Stromness Bay, but they were alive. "Just when things looked their worst they changed for the best," wrote Shackleton, In Punis Paname Guiukir Kahgif Collection, Handwar failure."



Frank Worsley's sketch of South Georgia maps the route he, Thomas Crean, and Shackleton took from King Haakon Bay, left center, to Stromness, right, mistakenly marked Husvik. Leaving the others to rest, they trekked, bone weary, for 36 hours, crossing the island's unknown interior.

uncanny instinct for assessing wind and tide, Worsley navigated mostly by dead reckoning, the sailor's calculation of courses and distance. Their proposed landfall, South Georgia, represented a mere speck in thousands of miles of ocean. Reluctantly the men decided to aim for the island's uninhabited southwest coast; if they overshot this landfall, prevailing winds would blow them east to other land. If they aimed for the inhabited northeast coast and missed—they would be blown into oblivion.

Near dusk on May 7, the 14th day, a piece of kelp floated by. With mounting excitement they sailed east-northeast through the night, and at dawn on the 15th day spotted seaweed. Land birds appeared in the thick fog, and when the fog cleared just after noon, McCarthy cried out that he saw land.

"There, right ahead, through a rift in the flying scud, our glad but salt-blurred eyes saw a towering black crag, with a lacework of snow around its flank," wrote Worsley. "One glimpse, and it was hidden again. We looked at each other with cheerful, foolish grins. The thoughts uppermost were: 'We've done it.'"

It was a triumph of navigation as much as

seamanship and endurance; even the five sightings Worsley had been able to make had involved a degree of guesswork, as the boat had pitched too wildly for him to gain secure fixes of the sun. As if out of spite, a full-blown hurricane roared up to thwart any attempt at landing that day. On top of all else, the men had discovered that their remaining water supply was brackish, and they were tormented with thirst. But on the evening of May 10, with Shackleton and his men at their very limits, the *Caird* ground onto a gravelly beach on South Georgia.

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about 150 miles distant by sea, too far for the battered boat and debilitated crew. Instead, Shackleton determined that he and two companions—Worsley and Crean—would cross overland to the stations at Stromness Bay. The distance was only 22 miles as the crow flies, but over a confusion of jags ged rocky upthrusts and treacherous crevasses. While the coasts of the island had been charted, the interior had never been crossed, and their map depicted it as a blank.

As dawn was breaking, they passed over a ridge and saw below the distinctive, twisted rock formation that identified Stromness Bay.

Shackleton's main concern was the weather, as a blizzard in the mountains could finish them. But at 3 a.m. on May 19 the conditions were right, and—by a gift of providence—there was a full, guiding moon.

The highest mountains on the island were less than 10,000 feet, and by strict mountaineering standards the journey was not technically difficult. A modern professionally guided traverse requires that each climber take the following equipment: Sleeping bag (rated to +10°F), closed-cell foam sleeping pad, climbing boots (preferably double), waterproof gaiters, one set pile jacket and pants, one extra pile jacket, one waterproof jacket, one waterproof pants, two sets of mitts (one waterproof), spare gloves, lightweight balaclava, face mask, camp booties, vapor-barrier socks, long underwear, one large pack, crampons, one ice ax, two ice screws, sunglasses, goggles, water bottle, Swiss army knife, sunscreen, skis with climbing skins, ski poles, waterproof bags. Guides provide tents, stoves, radio, first aid kits, climbing ropes, snow shovel, food and fuel, and crevasse rescue equipment.

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"We decided to . . . make the journey in very light marching order," wrote Shackleton. "We would take three days' provisions for each man in the form of sledging ration and biscuit. The food was to be packed in three socks, so that each member of the party could carry his own supply." They also carried matches, a cooking pot, two compasses, a pair of binoculars, 50 feet of rope, a Primus stove filled with enough fuel for six hot meals, and McNish's adze in lieu of an ice ax. They were dressed in threadbare long woolen underwear worn under ordinary clothing that had not been changed for seven months. For traction on the ice McNish had also put screws from the James Caird in their boot soles. Their frostbitten feet had not regained feeling in the nine days since their landing.

With moonlight glinting off the glaciers,

Shackleton, Worsley, and Crean left their companions and set out from the head of King Haakon Bay into the mountains. Guided only by common sense, they made three failed attempts to pass through the rocky crags that lay athwart their path. The fourth pass took them over just as daylight was failing. After an initial precipitous drop, the land on the other side merged into a long, declining snow slope, the bottom of which lay hidden in mist.

"I don't like our position at all," Worsley quotes Shackleton as saying. With night coming, they were in danger of freezing at that elevation. Shackleton remained silent for some minutes. "We'll slide," he said at last. Coiling the length of rope beneath them, the three men sat down, one behind the other, each locking his arms around the man in front. With Shackleton in the lead and Crean bringing up the rear, they pushed off toward the pool of darkness below.

"We seemed to shoot into space," wrote Worsley. "For a moment my hair fairly stood on end. Then quite suddenly I felt a glow, and knew that I was grinning! I was actually enjoying it. I yelled with excitement, and found that Shackleton and Crean were yelling too."

Their speed slackened, and they came to a gentle halt in a snowbank. Rising to their feet, they solemnly shook hands all round. In only minutes they had descended 1,500 feet.

They tramped on through the night, half asleep. More blunders were made as they became too tired to calculate the lay of the land. But as dawn was breaking, they passed over a ridge and saw below the distinctive, twisted rock formation that identified Stromness Bay. They stood in silence, then for the second time turned and shook each other's hands.

At 6:30 a.m. Shackleton thought he heard the sound of a steam whistle. He knew that about this time the men at the whaling stations would be roused from bed: If he had heard correctly, another whistle should sound

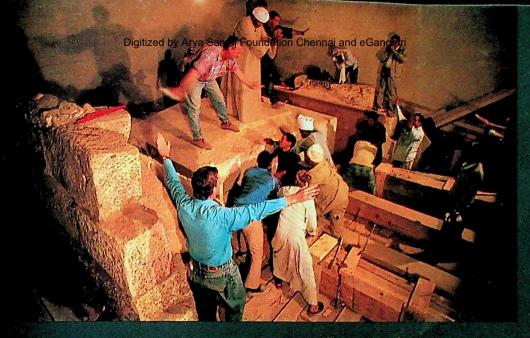
he serene face of Iufaa, an Egyptian priest, greets the mortal world for the first time in 2,500 years. Deep below the desert sands; archaeologists from the Czech Republic's Charles University uncovered the rarest of finds, an unlooted tomb with hundreds of artifacts. From beneath the lid of a colossal stone sarcophagus workers removed mud bricks and plaster (far right), exposing an inner sarcophagus carved in Iufaa's image and decorated with a scarab, symbol of eternal rebirth, and protective hieroglyphs. The next day the inner sarcophagus was opened, disturbing Iulaa's peaceful afterlife but revealing much about his world

A011SII LOIND

By ZAHI HAWASS

Photographs by KENNETH GARRETT





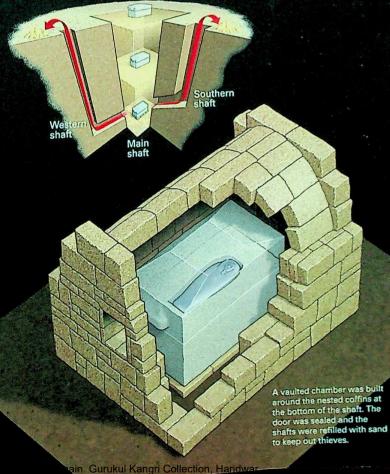
Engineering ancient and modern

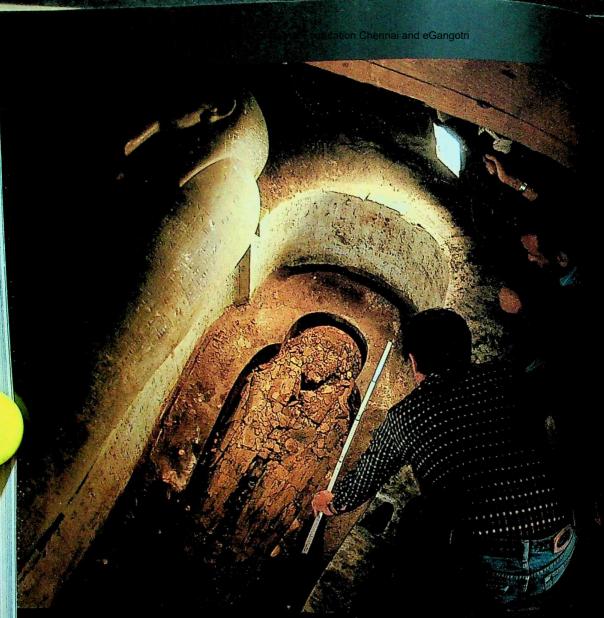
top! It's finished!" shouts team architect Michael Balík (above, in plaid shirt). The dangerous task of shifting the 24-ton lid of the limestone outer sarcophagus is complete. For nine days the workers chanted, drowning out the sound of ratcheting gears as they cranked a series of jacks, lifting the lid, then pushed it aside inch by inch. Any slip could have damaged the burial chamber's walls or sent the slab onto the crew.

Quiet anticipation
replaces noise and sweat as
the lid of the basalt inner
sarcophagus is hoisted (left).
We're anxious about what
we'll see next," says chief
archaeologist Ladislav
Bareš.

lulaa's nested
coffins lay at the
bottom of an 82-foot
shall. How did the
ancients lower up to 55
tons of stone? They likely

used narrow side shafts that joined the main shaft near its base. All three shafts were filled with sand, and the sarcophagi were placed atop the main shaft. Like a toy boat in a draining bathtub, the load descended as workers removed sand from the side shafts.





The bead-shrouded mummy

Tike Russian dolls, each coffin yields another. A decayed wooden colfin, its carved face barely visible (above), lies inside the basalt sarcophagus. Rotted wood means that moisture has penetrated the seal of the sarcophagus. Even the most skillfully embalmed mummy must be kept dry—difficult in a humid shaft only a few feet above the water table. Iufaa may have been decomposing for centuries.

Piece by piece, workers remove the wood. What they uncover stuns the team: a delicate network of glazed beads (opposite) the remnants of a shroud. Below a banded collar appear the winged goddess Nut and the sons of Horus, protectors of the dead. "Fantastic," says Czech anthropologist Eugen Strouhal, "I've never seen one so remarkably intact." The find forces an agonizing decision. Should the

team take days to preserve the fragile shroud and risk losing the chance to study the rotting mummy? Decay isn't the only threat. The site may be a target for looters. Egypt's Supreme Council of Antiquities chooses a compromise. Iufaa will be moved to a lah for analysis. The shroud is photographed and the beads collected. "We hope to reconstruct it in the future, says a resigned Miroslav Verner, the team's leader.



Who was Iufaa?

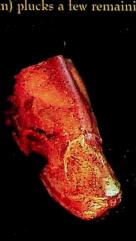
After a prayer four trusted workers bear Iufaa's crude new coffin from his tomb. A truck waits nearly a mile away to take his remains to a radiography lab at Giza. Eugen Strouhal eagerly follows. In decades of research he has never had a chance to study a mummy from an undisturbed burial.

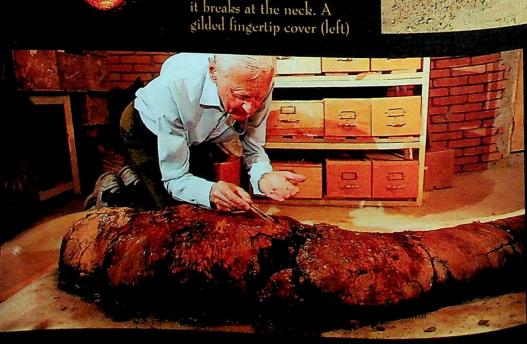
At the lab Strouhal (bottom) plucks a few remaining



beads as he prepares Iulaa for the x-ray machine. Ancient embalmers didn't give the corpse first-class treatment: Its wrappings weren't all saturated with moisture-resistant resin. The mummy, already broken at the pelvis, crumbles with each touch. Soon it breaks at the neck. A gilded fingertip cover (left)

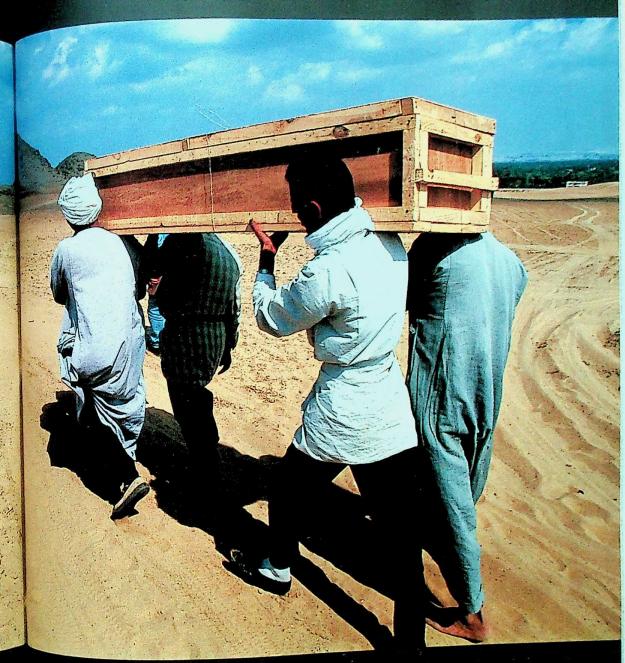








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falls from the gap. All of lufaa's digits are sheathed in gold. His fingers, held over the throat in an armstrossed pose, glow white in the x-ray.

Though eight of Iufaa's

molars are missing, he

probably wasn't more than
Strouhal detects no signs of
molars of the probable of the probable

and an administrator of palaces. His titles and his grand tomb imply a life of privilege and prosperity. Lector priests belonged to an elite class, serving gods and king by reading spells and rites.

Iufaa lived centuries after Egypt's greatest glory had faded. Pottery from the tomb suggests that he came of age during the 26th dynasty, a time of cultural renaissance, but died in the 27th under the rule of Persian conquerors. What did Egyptians believe about death and the afterlife in this transitional time? What can the tomb tell us about relations between native priests and the foreign regime? The mummy is mute, but study of the tomb's artifacts and inscriptions may provide answers.

After weathering an economic slump that hit hard as a hailstorm in the 1980s, Nebraska his

rebound

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By ROFF SMITH Photographs by JOEL SARTORE

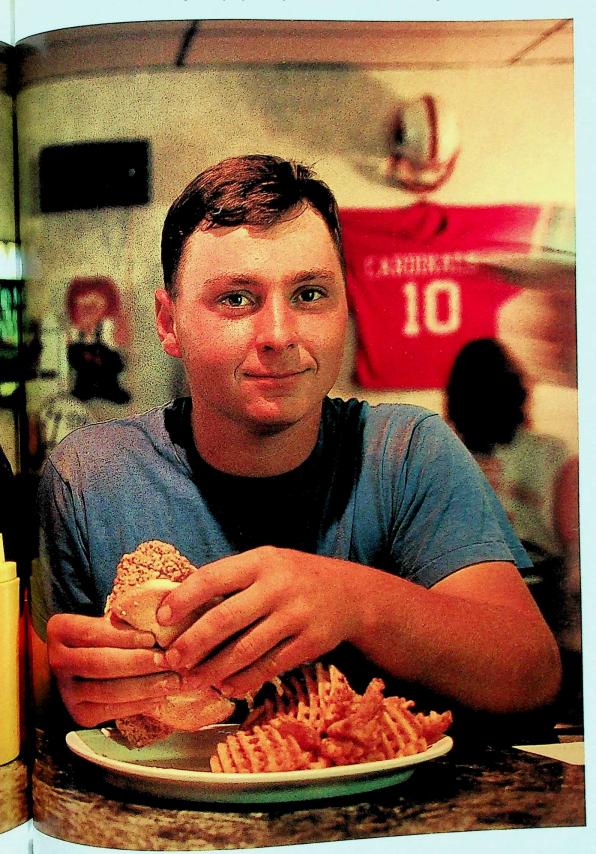
Standing Tall Again

bounded, reinventing itself while still looking out for traditions like the Big Rodeo at Burwell.



To fuel up, Chris and Nick Holste chow down at the CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar. Hired farmhands,
the twins keep almost identical

sip a so, then fix gearbox they're



schedules. Up at 6 a.m., they'll fields. Dimes and then, in they fix tractors, balers, and summer, a few more hours of searboxes till lunch. After and potatoes and then, in they're be they're be they're be they're be they're be they are the are they are the they are they are they are they are the are the are they are





HERE ARE TWO THINGS Nebraskans want you to know about their state's geography. The first is that when the University of Nebraska Cornhuskers are playing a home game, Memorial Stadium in Lincoln becomes the third largest city in the state. There hasn't been an empty seat there since a game against Missouri on November 3, 1962—a string of 220 consecutive full houses. The second is that Nebraska ain't flat.

"Any time I hear somebody say Nebraska's like a pool table, I know they've zipped across on I-80 and haven't seen a thing," says Don Hutchens, executive director of the Nebraska Corn Board. Certainly they haven't tried to put a car into first on the surprisingly hilly streets of Omaha. Or stopped to admire the view of the North Platte River Valley from the top of Windlass Hill, a pitiless grade on the Oregon Trail that broke the backs and spirits of a generation of pioneers. Or bicycled across Nebraska, as I did in the summer of 1980. That trek left me with both a working knowledge that Nebraska's eastern edge is at an elevation of 840 feet while its western is just over 5,400 feet and a lingering fascination for the way horizons fall away on the plains.

sprawl near Omaha and Lincoln. But west-

ern Nebraska still looks like home to cowboy

Mark Vinton (right), who grew up in the

Nebraska is a land to be taken slowly, imaginatively. There are no mountain ranges in the distance to lure you on, as there are on the prairies in Colorado. Nebraska's character is more subtle, closer to hand: sunflowers drowsy with summer heat, the glow of a cornfield against the purplish backdrop of a storm, a flock of sandhill cranes rising from the marshes of the Platte River.

A lot of corn? Sure. More in fact than any foreign country except China and Brazil. But Nebraska is also a computing and telecommunications hub, part of an emerging "silicon prairie." Wholesome? Nebraska defines the word. But just as you can meet Miss "Middle of Nowhere" at the annual children's pageant in Ainsworth, you can also run afoul of big-citystyle street gangs in Omaha. Speed through Nebraska's 19 million acres of cropland and read: homogeneity. Go slowly enough to make out the names on the farm gates—Zitterkopf, Foos, Swanson—and read the story of America's great melting-pot migration westward.

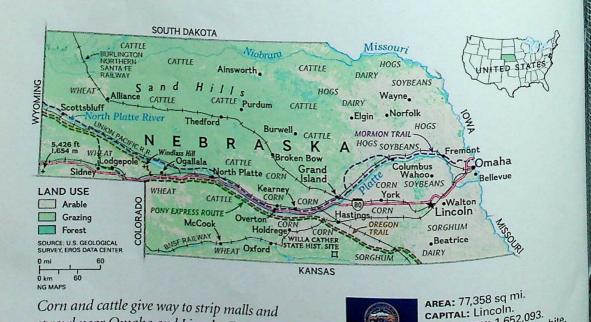
Yet for every person who chose to put down roots in Nebraska, countless more have used it as a doormat to somewhere else. In the mid-1800s more than 400,000 pioneers passed

POPULATION: 1,652,093.

3.6% black, 2.3% Hispanic. economy: Agri-

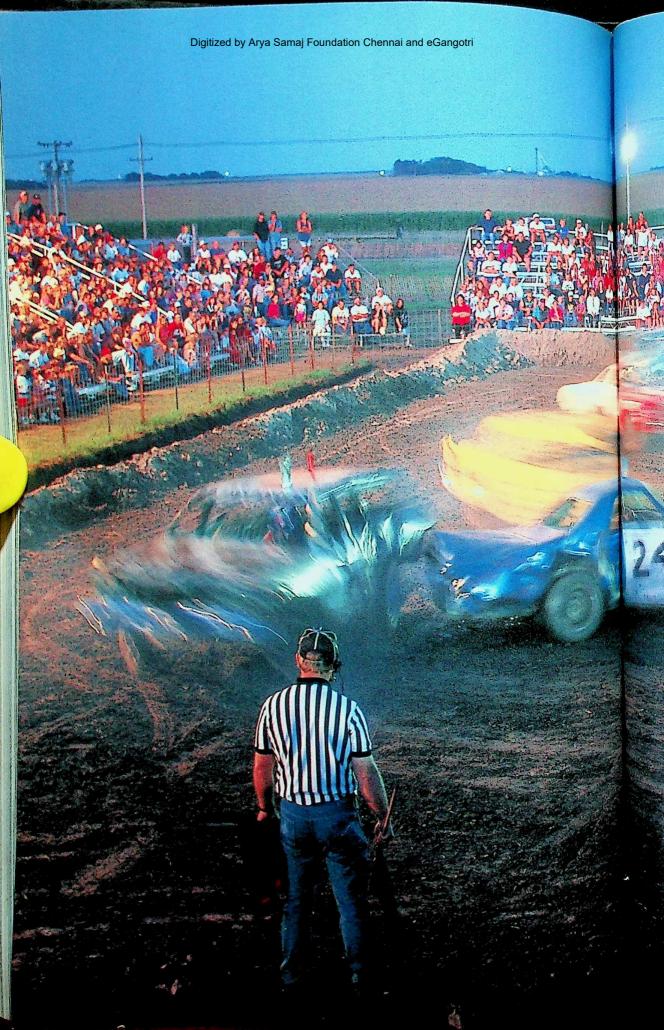
culture (cattle, corn, hogs), manufacturing, telecomputers

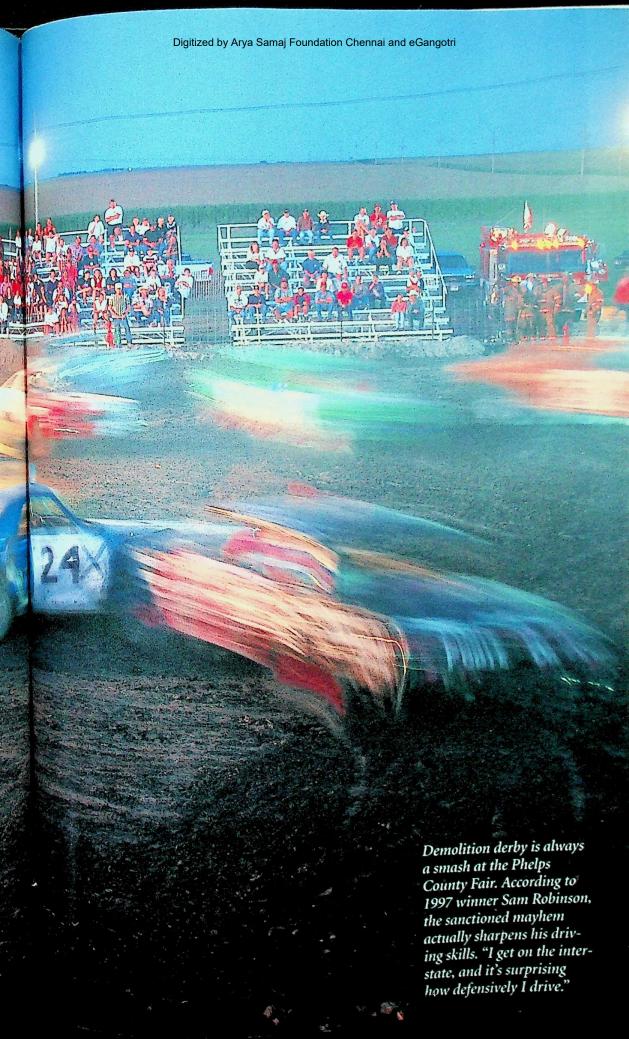
RACIAL/ETHNIC: 93.8% White,

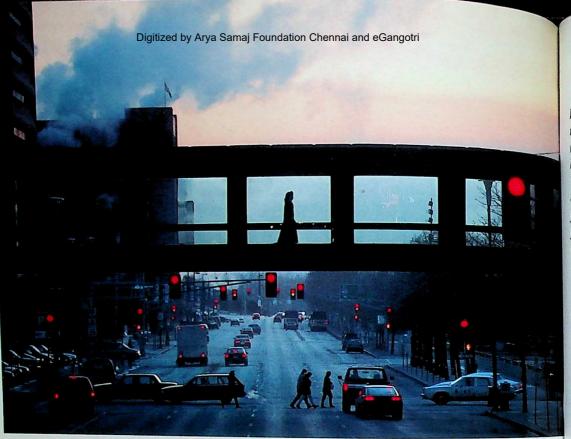


Sand Hills on a 14,000 acres reubth. Domain. Gurukul Kangri telepontum manations. PER CAPITA INCOME: \$23,047. UNEMPLOYMENT: 2.9%.









spouses, hunker down for an evening of cold calling. Computers dial numbers, randomly selected from a list supplied by the client company, and the room buzzes with scripted conversation: "Hello. May I please speak to Mr. (Mrs.) _____. This is ____ from DialAmerica. How are you tonight?"

Shanda walks among her reps, eavesdropping on a cordless phone to check that their approach is bright and full of confidence. She gives pep talks where needed, congratulates others on a good sale. It is high-pressure work. In a four-hour shift each rep will place more than a hundred calls and be expected to score sales at least 8 percent of the time. Shanda tracks their successes (or failures) hour by hour in red marker on the "paceboard." If you achieve "elite" status, your extra commissions could earn you up to \$14 an hour-well above the guaranteed \$8.50 an hour minimum. Lag behind too often, and you could be going home. "If you last four months, you're a long termer," says David Haller, sales manager for DialAmerica's five Omaha offices. Haller is an ultra long termer who started working the phones 12 years ago. "A lot leave and then come back after a break. There's always jobs."

Selling by phone may seem modest roots for a high-technology boom, but Omaha's central time zone, neutral accents, and a diligent, modestly priced workforce made it a good bet for toll-free call centers and telemarketing operations. "This was the only place in the country where you could get a WATS line installed in a day," Haller recalls. Omaha's advantage was the U.S. Strategic Command, which has its nuclear weapons command center buried in rolling farmland nine miles south of the city. The facility required huge amounts of telecommunications capacity to cope with the flood of intelligence coming into the base and to be absolutely certain of communicating instantly anywhere in the world.

With the growth of more sophisticated data processing in the 1980s, the city spread out from the hulking redbrick warehouses along the riverfront to gleaming, campus-like facilities in the western suburbs on what had been cornfields. One such operation, First Data Corporation—a five-billion-dollar-a-year data processor for credit and debit card companies—is Omaha's largest private employer, with more than 7,500 workers on the payroll, "Over be compared to the payroll,"

"Over here is what we call the War Room, Garold Bell, director of network installation, said, leading me to a glass viewing wall so could peer into a hushed, dimly lit nerve center where scores of computer terminals, some

Foot soldi telemarke (right) bo biggest in The city (communi for the U. financed of, among state-of-t network. mild mia helped O of telema which no than 4 pe population not," say.

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Foot soldier in an army of telemarketers, Charlotte Jones (right) bolsters one of the biggest industries in Omaha. The city (left) serves as a communications nerve center for the U.S. military, which financed the construction of, among other things, a state-of-the-art telephone network. That, plus the locals' mild midwestern accents, helped Omaha lure scores of telemarketing companies, which now employ more than 4 percent of the city's population. "Believe it or not," says Jones, "I've received only three calls from telemarketers in my life."

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banked three high, glowed with graphs, digits, and charts in exotic colors. Five large screens lined the rear wall with more information, and digital clocks showed the time in each zone from Maine to California. About 30 men and women, with ID tags prominently displayed, hunched over their keyboards, sipped coffee from cardboard cups, or leaned back in their ergonomic chairs murmuring to one another.

This was the data center, a windowless, high-security facility built to withstand 200-mile-an-hour winds and other natural disasters, where workers have their palm prints scanned by computer to get inside. For 180 million cardholders around the world spending authorizations blip through the computers in here. "During the Christmas shopping season," Bell said, "we can handle up to 800 transactions per second."

Finding the people to keep this going is a perpetual conundrum for Mark Eibes, the company's staffing director. "I've got 750 vacancies at all levels I need to fill," he said, asking me only half jokingly if I'd like to apply for More than 40,000 people have moved to Omala in the past decade, but that pool of new-demand. Employers have set up toll-free job

lines and offered cash bonuses to workers who bring in a prospective employee, and the Chamber of Commerce has websites extolling the good life in Nebraska. "Discover how living in Omaha can bring you one of the best environments for raising families in the nation." The chamber even has a recruiting team that roams the country trying to induce workers to come to the heartland—a resonance of Nebraska's golden age of the 1880s when railroad promoters scoured Europe looking for migrants willing to stake a claim on the prairie.

"It can be hard to get top talent to come out here from the coasts," says Eibes. "Either they don't know where Nebraska is, or they think we've got buffalo wandering the streets at night. Once we get them out here for a look, they don't want to leave."

F OMAHA plays to its well-scrubbed stereotype of good schools, first-rate hospitals, and affordable housing, it spices that image with the unexpected: the Henry Doorly Zoo, which has the world's largest indoor rain forest; or the Joslyn Art Museum, internationally known for its Maximilian-Bodmer collection; or the birthplace of Malcolm X over on Pinkney Street.

"I'd wanted to see the American Midwest,"



said Christine Kriegerowski, a photographer from Berlin on a three-month residency at the Bemis Center for Contemporary Arts, America's largest urban artist colony. "My friends in New York warned me to expect beehive hairdos and butterfly glasses, but it's not like that at all. The cafés in the Old Market feel very European." Indeed Omaha has had its bohemian side from the beginning, with actors and singers coming up on Missouri River steamboats to perform in the theaters and saloons.

The city has a tough side as well. The heart-land location, which made Omaha a crossroads for generations of Americans, has made it a convenient staging post on the drug pipeline between New York and California. Los Angeles street gangs have set up local chapters in the tough neighborhoods of North and South

Omaha, which, with their cracked sidewalks and tacky neon signs, resemble the poorest parts of any of the nation's metropolises.

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During my stay the Omaha World-Herald carried a front-page special report about the emergence in South Omaha of new gangs with Salvadoran connections. But assessing the extent of gang activity is difficult in this image conscious city. Statistics on gangs were a city hall secret until this year, and the officer who spoke to the newspaper got a severe dressing down from police brass and the mayor's office. "Year and police brass and the mayor's aid."

"Yes, street gangs have set up shop here," said
Father Damian Zuerlein, whose church, Our
Lady of Guadalupe, is the social focus of the
Hispanic community in South Omaha.

yes, we have drive-by shootings, street crime,
and drugs—no city is immune these days, not

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128



even Omaha. But this has to be put into perspective. We've gone from denial—it couldn't happen here—to breathless headlines exaggerating the problem. We're a long way from being another South Central Los Angeles."

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According to FBI statistics for cities with a population of more than 100,000, Omaha's crime rate in 1996 was less than the Los Angeles/Long Beach area's, but greater than New York City's.

be unfolding against a backdrop of inner-city brick or freshly built suburbs, 96 percent of the state's land is and farming. At Kevin Swanson's farm near overton in the central part of the state, the corn

Reflected glory: Five-time national football champions, the University of Nebraska Cornhuskers pack 75,000 rabid fans into Memorial Stadium on game day. The team has sold out every regular-season contest since 1962. Husker Fever, it's called, and it shows no sign of breaking.

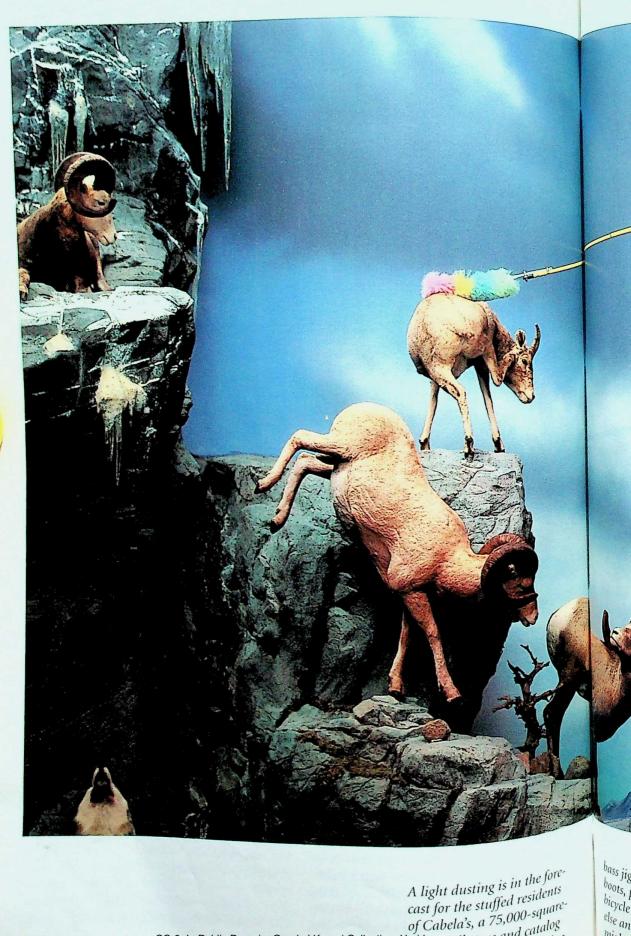
harvest was gathering pace when I arrived in mid-October. An unseasonal blizzard had plastered the cornstalks with heavy, wet snow a week earlier, adding a sense of urgency.

"Every day the crops sit out here is another day of risk," Swanson, 38, explained, lowering the header on his combine to scoop up the storm-damaged stalks. "Another storm could spell ruin." We were sitting in the heated cabin of his John Deere (cost: \$175,000), riding above a sea of cornstalks. All the traditional harvest images were here, props in Nebraska's longest running play—heavily laden farm trucks growling in low gear down the roads taking the crop to town, blackbirds pecking at grain spilled on the blacktop, pheasants rocketing up from the cornstalks in front of us. A closer look revealed a more modern Nebraska.

"We've already done more work since breakfast than my grandfather would have been able to do in his whole season," said Swanson, a fifth-generation Nebraskan whose family homesteaded some of the 3,000 acres he farms today. And it was only 10 a.m.

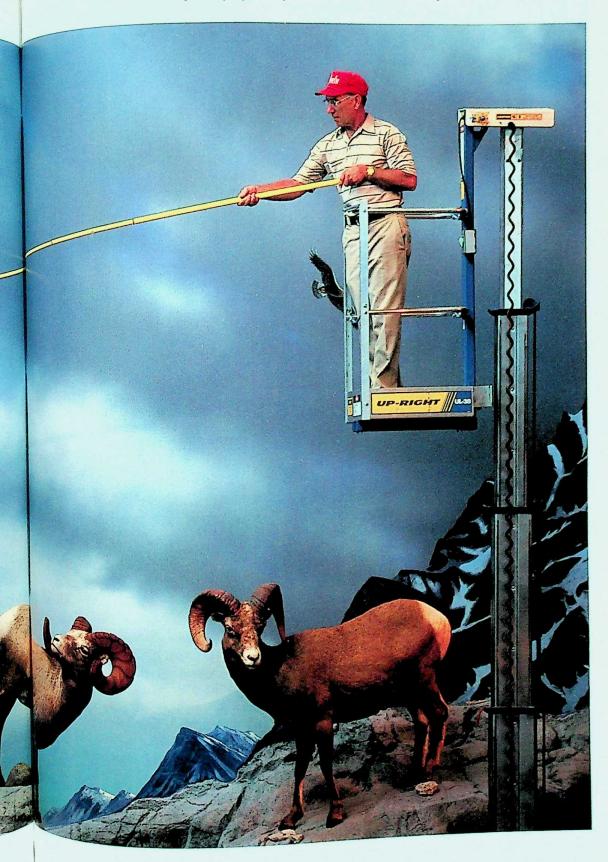
The Homestead Act of 1862, which offered settlers 160 free acres, was written with people like Swanson's ancestors in mind. More than 68,000 homesteaders staked claims in Nebraska, and tens of thousands of others bought cheap land from the railroads—Germans mainly, but thousands of Russians, Czechs, Lithuanians, Swedes, and Irish as well. Emancipated slaves settled here, and Mexicans came to work the sugar beet fields, the railroads, and the meatpacking houses.

By 1900 Nebraska's population had reached a million, nearly half of whom were born overseas, and more than 120,000 family farms dotted the state. But economics changed farming, and settlers who had overcome drought, grasshopper plagues, and bank failures found themselves forced either to sell up or to buy out their neighbors to expand their operations. The 55,000 farms in Nebraska today average



A light dusting is in the fore-cast for the stuffed residents of Cabela's, a 75,000-square-of Cabela's, a 75,000 catalog showroom in Sidney. Selling

might.



bass jigs, rifle scopes, hiking boots, propane cookstoves, biCycle racks, and anything might dream about, the store

also features this "tribute to sportsmen"—an elaborate Rocky Mountain fantasy that Rocky Mountain Junion

Rocky Mountain Junion

Might dream about, the store

Rocky Mountain Junion

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Nebraskan flatlanders Collection, Haridwar Nebraskan flatlanders. Digitized by Arya Samaj Foundation Chennai and eGangotri

Iron abs and buns of steel don't carry much weight with the Chickendales, a group of local college wags who parade during the Chicken Show, a daylong fowl celebration in Wayne. "There's not much to do out here," says photographer Joel Sartore, a native Nebraskan. "And that fuels our, uh... creativity."

just over 850 acres, about double the size they were in 1945.

"Farming is a big business, just like any other—you have to grow bigger to survive," said Swanson. As we rolled through the windswept field, each pass of the combine gobbled up eight rows of corn, picking, husking, and threshing at the rate of 2,500 bushels an hour—a full season's work in the hand-threshing days of the 1930s. Swanson pointed out that this particular tract would have been considered too hilly to plant just 30 years ago. "I'd love to see the look on my grandfather's face if he could see the kinds of things we're doing now. Forget your image of a Nebraska farmer in straw hat and overalls."

Swanson explained that seven satellites, 12,000 miles above Nebraska, were communicating with a global positioning device mounted on the dashboard and an onboard computer that provides second-by-second analysis of crop yield. "When I get home, I download this information onto my computer, which spits out one of these." He passed me a sheet of paper, whose patterned magenta, cyan, and yellow splotches reminded me of a CT scan. "This map shows acre by acre what my yield has been on that particular field. I've got a soil scientist working with me, and we'll go over all this and try to find more efficient strategies for planting and seeding."

As he spoke, I noticed that we were at 99 degrees 33 minutes west longitude—right on the edge of what used to be called the Great American Desert, which 19th-century Army explorers and surveyors believed began at the 100th meridian. Rainfall hereabouts averages 17 inches a year—7 more than in a true desert—but the label stuck, frightening off bankers and farm insurers who wouldn't lend a dime for any agricultural purpose beyond this invisible line. Nobody reckoned on the Ogallala aquifer, an underground pool larger than Lake Huron beneath Nebraska

and eight other states.* Nebraska's share of the aquifer is sufficient to flood the entire state to a depth of 34 feet or, more usefully, to irrigate eight million acres of crops, including all of Swanson's land.

"The summer of '97 was the driest in 60 years," Swanson said. "But instead of a dust bowl, Nebraska harvested one of the biggest, corn crops on record—over a billion bushels.

That's enough corn to fill 300,000 freight cars, yet about three-fifths of the bounty never leaves the state. For all Nebraska's Cornhusker image, beef is king—a four-billion-dollar-ayear industry rivaling that of Texas. And cattle eat a lot of corn. Farmers and cattlemen need

*See "Ogallala Aquifer: Wellspring of the High Plains," by Erla Zwingle, NATIONAL GEOGRAPHIC, March 1993.

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each other, but flavors of the old range rivalries temain, even if today it's simply a matter of calling a cowpuncher a cowboy, and not a farmer. "Don't call us farmers," a rancher's wife named Marianne Beel said to me after I made a slip in conversation. "Farmers raise crops. Ranchers raise cattle. There's a big difference." Ranching has always drawn the free-spirited and restless. Back in the 1870s the Nebraska town of Ogallala was known as the Gomorrah of the Plains—a shantytown of Saloons and brothels where cowboys up from lexas liked to shoot billiards with six-guns. hundred thousand head of cattle passed through in 1876 alone. Nowadays more than 160,000 head move each year through Ogallahonel yard, one of the biggest in the state, although a drive down the main street—past

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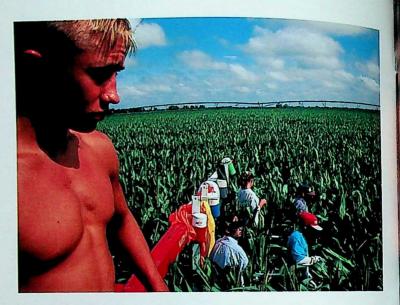
Cornhusker Lanes & Lounge, Moose Lodge #1624, and the Optimist Youth Park—speaks more to Midwestern geniality than to Boot Hill.

I went to the cattle auction with Merle Knode, an independent buyer looking for bargain-priced beef. The first few animals didn't excite him. But when cattle from the Sand Hills were trotted into the ring, Knode began bidding in earnest. He bought 42 head before lunch. "They raise some of the finest cattle in the world up in the Sand Hills," he said with conviction. "You want to see the best of Nebraska cattle, you go up there."

Heading north on Highway 61 into that dusty immensity of earth and sky, an Easterner can feel the pull of the range as the horizon drops away. To some, like Atlanta media mogul Ted Turner, the lure is irresistible: He bought

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Developing superior strains of corn requires a sophisticated understanding of plant genetics, vast amounts of land and water, and plenty of young kids hungry to make a buck (opposite). Their field assignment: to detassel corn—removing pollen-bearing tassels from plants to prevent them from self-pollinating, thereby giving strategically positioned male plants nearby a chance to do their job. To reach the top of the plant, field hands get a mechanical lift (right). The goal is to create improved hybrid seeds that will produce vigorous corn resistant to wind, drought, and disease.



52,000 acres out here and has established a buffalo herd. I was heading toward Purdum and the ranch of an old Nebraska family, where Leon and Judy Morris were branding 61 fall calves. The scene was pure Charles Russell: Blowing snow and wind-scoured starkness, cowboys on horseback, the bawl of calves and the smell of burned hide as the quarter-circle-triangle made its mark.

The Morrises own about 215 head of cattle—barely enough for a family of four to scrape by. The branding took all morning, then we rode back to the house to a hearty lunch of Swedish meatballs, casseroles, and salads. Leon showed me an old photograph of his grandfather standing beside a sod hut—Nebraska marble, it was called in those days. "They came from Iowa in a covered wagon sometime around 1891 and homesteaded 160 acres just west of Thedford," Leon said.

Leon talked of the blizzards that howl through the winter, the baking summer afternoons, and the winds that blow for days on end. During the spring branding, neighbors make the rounds of each other's ranches to help out. They finish the day with a barbecue, cold beer, and games of horseshoes. "Lots of prairie oysters," he said, referring to testicles cut that day from the young calves. "Lightly

fried-it doesn't get any better than that.

"Ranching is a lifestyle, not a job," he continued. "At best we'll get only a 3 percent returnand face it, you could do better than that selling up and getting interest on the money. The past few years we've lost money. Beef prices are low, people are eating less meat, and we've got big city millionaires coming here, buying hobby ranches and driving up taxes and land values. But things go in cycles. This year we'll make a little money. For all ranching's hardships, I wouldn't do anything else."

Sitting across the table, Mark Carr, who owns a neighboring ranch, agreed about the way of life. But he admitted that as a parent he's relieved his youngest son has found a job with the Union Pacific Railroad down in North Platte. "He's earning \$40,000 a year, with full medical and dental, and his wife is a brakeman on the railroad. She's also earning \$40,000 a year. Nobody's ever going to give them any thing like that out here." About 12,000 Nebraskans work the railroads—one of the state's kans work the railroads—one of the state's higgest employers—although that's less than half as many as during the glory days of steam in the 1920s.

Trevor Cox, another neighbor come to help with the branding, is 13 years old but already knows his mind. When Carr joshed him about Kul Kangri Collection. Haridwar

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maybe living in the city one day, he shook his head and laughed. He'd sized up Lincoln when he'd entered the state wrestling championship (he won his weight class). "There's no way I'd ever live in the city. I don't even like going into Broken Bow," he said, referring to a town of 3,698 some 50 miles away. "It's too cramped. Out here in the Sand Hills is where I belong."

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be defying a long-term trend in rural Nebraska. Since the Dust Bowl years all but 19 of the state's 93 counties have lost population, mostly the young. The exodus has left redbrick main streets, once symbols of heartland American pride, boarded up and dying.

"I just want to sell up and get out," sighed Nicola Fraass, 73, who waits for customers behind the marble-topped soda fountain in Fraass' Sundries, her musty old cigar and candy store in Lodgepole, population 368. "But the only people that seem interested are antique dealers. They want to buy my cash register or these old-fashioned shelves or that Hamilton Beach malt machine. I tell them, 'No.' I want to wait and sell this place in one piece."

Some small towns, such as Broken Bow and McCook, have attracted telemarketing operations that haven't found enough workers in the

overheated job markets in Lincoln and Omaha. Other rural towns, such as Sidney in the panhandle, have made their own luck. What Dick Cabela, a fisherman born and bred near here, and his wife, Mary, started in 1961 as a kitchentable business selling fishing flies has grown into an outfitting empire in a new five-million-dollar complex on the edge of town. Cabela's catalog, shipped to 55 million customers in 115 countries, offers outdoorsmen 60,000 different items. Poke your nose into the Country Kettle café around lunchtime, and you'll see what a business like this can mean to a town of 6,000: Of the café's 21 patrons, 9 were wearing green Cabela's uniforms.

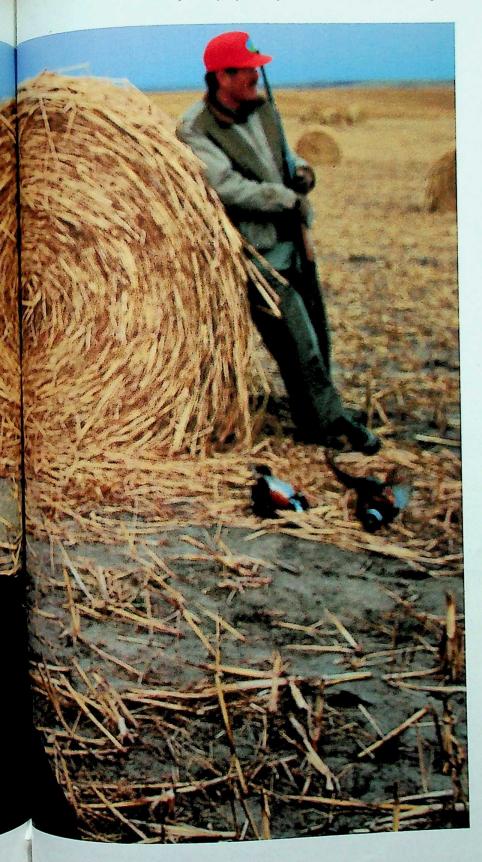
"Economists back East have been saying for years that small town U.S.A. is an endangered species," scoffed Jack Lowe, 90, who joined the Sidney Telegraph as a cub reporter in 1927 and has served as both its editor and publisher. Now in semiretirement, he's the paper's columnist. "Well, towns like Sidney have been proving them wrong time and again."

Sidney has had near-death experiences, however, most recently in 1967 when the Army closed a supply depot that had been the main employer. If Cabela's hadn't caught on, Sidney itself might have faded out, like scores of other farm towns across the plains.



A bird in the hand will soon become a tasty casserole, says

John Ellsworth, who bagged



Broken Bow that attracts to provide extra food and to hundreds of participants. protect their livestock," says
Hunting has always been big Ellsworth. "Me, I enjoy it for the outdoors, the exercise, and my great-grandparents hunted" the charlenge will Kangri Collection, Haridwar

Whips of lightning crack the sky near Walton in this time exposure. The lean years of the 1980s drove many Nebraskans off their once prospering farms. Now rural areas are resurgent, thanks in part to personal computers and other hightech gear that help people live where they likeand many like rural Nebraska.

We were sitting in the Telegraph's editorial office in back of a brick building on Illinois Street, where Lowe and Ralph Olsen, the paper's present publisher, were plotting strategy. A few weeks earlier the Sidney Daily Sun had gone into production—the first new daily in Nebraska in 50 years and one of only five to open anywhere in the United States last year. The launch sparked an old-fashioned newspaper war among the Telegraph, the Sun, and a new weekly, The Panhandle Town & Country, for the hearts, minds, and advertising dollars of Cheyenne County's 9,000 readers. Tactics included advertising discounts and \$100 rewards for hot tips. Lowe was loving the fight, boasting, however inaccurately, "Not even New York is a three-newspaper town anymore."

T'S A LONG MENTAL HIKE from Manhattan to Sidney, but nevertheless a Big Apple-style restlessness descends over the Nebraska Panhandle on fall weekends. Driving east, I could feel it on the highway, as sedans and pickups with University of Nebraska bumper stickers sped past. We were all heading for the same place, Lincoln, whose capitol buildinga monument to art deco-becomes visible 25 miles out. Designed by Bertram Goodhue in 1920 and built of pale brown Indiana limestone, its tower is capped by a dome and a 19,000-pound bronze of a man sowing grain. Looking up at it, I had the notion I was going into the Emerald City to see the Wizard. As a matter of fact I was, or at least the closest thing to it in Nebraska. I was going to "the Game."

Two hours before kickoff, and already there was a whiff of Christians versus the lions in Memorial Stadium. Whistles blew, horns sounded, and the Rolling Stones' "Start Me Up" blared on the public address system. Nebraskans in red Huskers sweatshirts, caps, and sweatpants shuffled through the gates, clutching tickets so valuable that divorcing couples have been known to fight over them in court.

Digitized by Arya Samaj Foundation Chennai and eGangotri

When I asked a policewoman if the crowd ever got violent, she laughed. "No. About the biggest headache we get is parents losing children, and when we ask what they were wearing, it's always the same—he was wearing red!"

Oklahoma trotted into this cauldron dressed in white. Their offensive line averaged 299 pounds a man, but—poor fellas—you had to feel sorry for them: It was like looking at heifers waiting to be slaughtered in the South Omaha stockyards.

Oklahoma's first drive ended in a crunching tackle, which shook the ball loose. Forty-seven seconds later Nebraska was on the board. Drums throbbed, the crowd screamed, and scores of red balloons rose from the stands. Late in the third quarter, with the score 55 to 0, Tom. Ocho Tom Osborne, then Nebraska's head coach,

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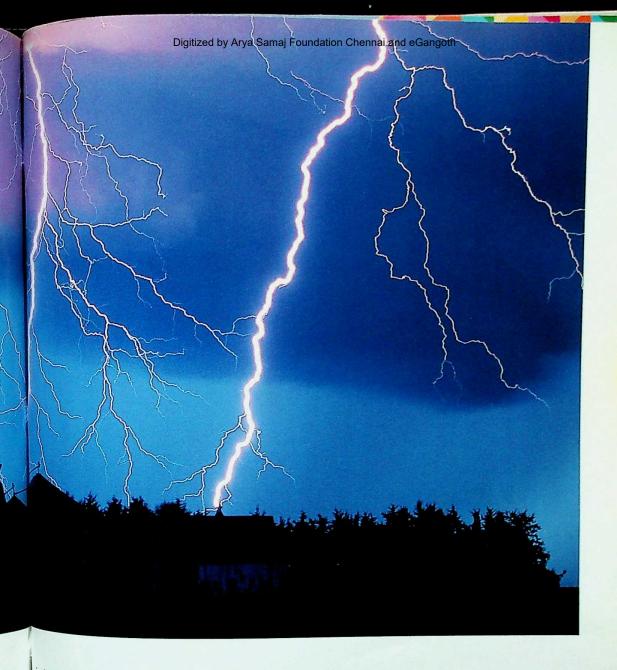
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Judged the game safe enough to blood his second- and third-string players. This slowed the rout a little. Oklahoma actually scored once, stunning the crowd to a glowering slence. It was the first time in three weeks anyone had scored against Nebraska. "Well, there goes the shutout," a man beside me muttered angrily, hands on hips. From the look on webraska put two quick touchdowns on the look of the clock for a 69 to 7 win.

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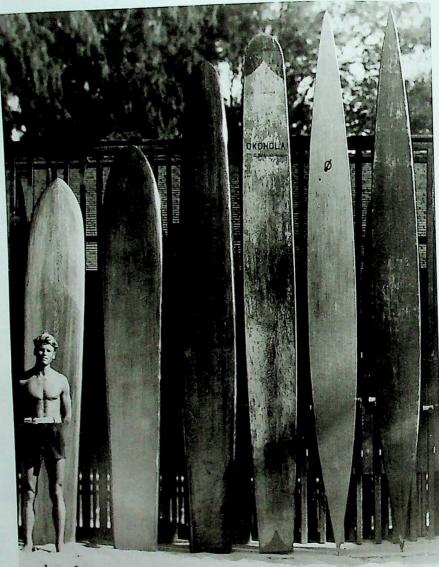
Although it was a typical score for the Cornlaskers, this game was special. It was Tom Oslach, making him, as we'd been reminded afternoon, the "winningest active coach in lege football history." As Oklahoma limped from the field, the band played martial music, 75,926 fanatics thundered in unison: "Go-Big-Red! Go-Big-Red!" and the rainy skies over Lincoln exploded with fireworks.

Back in 1918 Willa Cather wrote about growing up in Nebraska, about "blustery winters with little snow, when the whole country is stripped bare and gray as sheet-iron. We agreed that no one who had not grown up in a little prairie town could know anything about it. It was a kind of freemasonry."

These days Nebraskan brotherhood draws strength from the college football team, which connects the people of this grassland, defines them as Nebraskans in a way that their state's straight, seemingly arbitrary, boundaries cannot. It makes them world beaters, in that genial way that can slip by unnoticed.

Digitized by Arya Samaj Foundation Chennai and eGangotri

FLASHBACK



THOMAS EDWARD BLAKE

■ FROM THE GEOGRAPHIC ARCHIVES

Chairman of the Boards

The ancient sport of surfing was enjoying a revival when Tom Blake arrived in Hawaii in 1924. The blond Midwest-erner used knowledge he gained restoring antique boards for Honolulu's Bishop Museum to fashion his own collection (above). He patented the hollow paddleboard and was the first to fit a surfboard with a fin. Blake is also known for pioneering photography from the waves. In 1930 he submitted to the Geographic photos taken from a surfboard. The pictures, tinted blue at Blake's suggestion, appeared in May 1935 under the title "Waves and Thrills at Waikiki."

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NATIONAL GEOGRAPHIC

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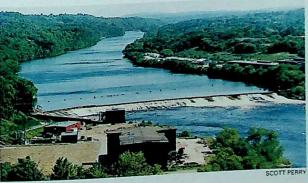


JIM PARKER

Maine Fish Win: Dam To Be Torn Down

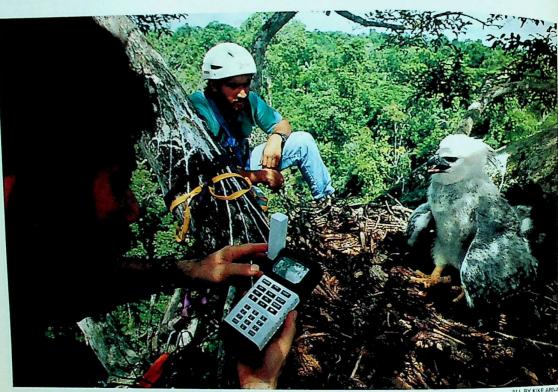
For more than 20 years fishermen in Maine have been trying to get rid of the Edwards Dam on the Kennebec River. Next summer they should finally get their wish.

For the first time the Federal Energy Regulatory Commission has ordered a dam removed when its owner wanted to keep it operating. Built in 1837 near the Kennebec's mouth on the Atlantic, the Edwards flooded a 17-mile fish-spawning stretch. "It damaged the seagoing fisheries," says Sue Scott of the Atlantic



Salmon Federation. Nine migratory species—Atlantic salmon, striped bass, shortnose sturgeon, Atlantic sturgeon, American shad, blueback herring, American eel, alewife, and rainbow smelt-have all but disappeared above the dam.

The dam generates one-tenth of one percent of Maine's electricity. Its removal may set a precedent: More than 600 other privately owned dams are due for review and relicensing in the next 15 years. Environmentalists have also targeted four federal dams on the Snake River in Washington State.





Harpy Eagles Have Friends in High Places

With a bird's-eye view of the Venezuelan rain forest, biologist Eduardo Alvarez-Cordero (top, at left) and field manager Rafael Alvarez prepare to fit a young harpy eagle with a satellite transmitter; Eduardo uses a global positioning system (GPS) receiver to check the nest's position. Many threats endanger the eagles—largest in the Americas here in the Serranía Imataca mountains. "Logging is ongoing, and now the area may be opened to gold mining," says Eduardo.

Sometimes he wins the trust of local farmers who may have hunted eagles but agree to show him the nests. "Indians kill them for feathers, and prospectors shoot them for food," he explains. "There is one farmer who has a stuffed harpy decorated with Christmas lights. We've seen it all.



He uses both GPS and geographic information systems (GIS) to locate and map a nest before loggers zero in, then persuades them to leave a buffer zone around it. He works for the Peregrine Fund, which runs the Harpy Eagle Conservation Program gram, also operating in Panama. There researchers measure a fledged eagle (above). Females, the larger sex. have a sex. sex, have a seven-foot wingspan and weigh 20 pounds. Both sexes are armed with thick, powerful legs with burget legs with burget legs. legs with huge talons for snatching up sloths on the fly. Raised at the Peregrine Fund's Boise, Idaho, headquarters, this is the Peregrine Fund's Boise, Idaho, headquarters, this chick (above left) and three other captive-bred harpies were released into Panama's Saberania National Park.

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NATIONAL GEOGRAPHIC, NOVEMBER 1998

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Polishing Up the Rust Belt in Old Buffalo

Abandoned by industry, as many as 450,000 hazardous sites, dubbed brownfields by the EPA, blight U.S. cities. Contamination, real or suspected, thwarts redevelopment. With state and federal funding Buffalo, New York, has tackled three dozen brownfield sites. A demolished paint company (above) is on the renewal list, and golfers already tee off from a driving range nearby. Where sparks flew in a Republic Steel complex, an 18-acre greenhouse produces some seven million pounds of hydroponic tomatoes a year.



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NATIONAL GEOGRAPHIC, NOVEMBER 1998

Illegal Wildlife— Status Symbols for Mob Bosses

Last spring in Naples during a crackdown on the organized-crime ring known in that city as the Camorra, Italian police discovered that several powerful bosses were illegally collecting exotic animals. While one gang member was in prison, officers found a lion, named Simba, on the grounds of his villa. Now the Naples zoo cares for Simba, as well as a leopard and a python confiscated during raids of other Camorra homes. TEXT BY JOHN L. ELIOT

Notice is Cosby v. products

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Legal Notice

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Please read this legal notice

Notice is hereby given, that proposed Settlements have been reached in the class action lawsuits, *Quin v. Masonite Corp.*, and *Cosby v. Masonite Corp.*, Plaintiffs in both *Quin v. Masonite Corp.* and *Cosby v. Masonite Corp.*, allege that the Masonite products are defective, causing Class Members to suffer damages. Defendants vigorously deny these allegations in both lawsuits.

Settlement Hearing

A hearing will be held before the Hon. Robert G. Kendall, located at Government Plaza, 205 Government Street, Mobile, Alabama, 36644 at 9:00 a.m. on January 6, 1999 to determine whether the proposed Settlement Agreements on file with the Court are fair, reasonable adequate, and in the best interests of the Settlement Classes and whether a Final Judgment should be entered approving the Settlement Agreements.

Masonite Woodruf Roofing

Who is Involved?

You are a member of the Settlement Class in *Quin v. Masonite* if you owned or own Property on which Masonite Woodruf Roofing has been incorporated and installed in the United States and US Territories from January 1, 1980 to the Date of Final Order and Judgment in this Action.*

Product Description

Masonite Woodruf Roofing is a roofing product composed of pressure bonded fibers designed to emulate the look of natural cedar roofing. It is made of real wood fibers that are molded in 12" x 24" shingles.

Proposed Claims Period

7 years from date of Final Order and Judgment for roofing installed from January 1, 1980 through December 31, 1989. ¹⁰ years from date of Final Order and Judgment for roofing installed January 1, 1990 and after.

Masonite OmniWood Siding

Who is Involved?

You are a member of the Settlement Class in *Cosby v. Masonite* if you owned or own Property on which Masonite OmniWood Siding has been incorporated and installed in the United States and US Territories from January 1, 1992 to the Date of Final Order and Judgment in this Action.*

Product Description

OmniWood Siding is an exterior Oriented Strand Board lap, panel, siding or trim product.

Proposed Claims Period

10 years from the Date of Final Order and Judgment.

*Excluded from the Class are persons who, while represented by counsel other than Class Counsel, resolved claims through full release, dismissal with prejudice or judicial action.

Settlement Terms

Eligible claimants, upon proper verification and independent review of damaged siding or roofing will be awarded damages according to a Compensation Formula established by the Settlement Agreements, unless the damage is subject to one of the specifically agreed upon causation exceptions. Class Counsel's attorney's fees will be paid by the Defendants based on 13% of actual claims made and will not be deducted from Class Members' payments.

Your Rights

Complete information about your rights as a Class Member, the Settlement approval process, how to exclude yourself from the Settlement Class, how to object or comment on the Settlement, and how to make a claim for repair or replacement costs including important dates and deadlines is available in the Notice of Proposed Class Action Settlement for each lawsuit. To obtain a copy:

(all: 1-800-256-6990

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or visit:

www.kinsella.com/masonite/

or write: Class Counsel c/o P.O. Box 925, Minneapolis, MN 55440-0925

Please Do Not Contact the Court or the Clerk's Office for Information. By Order of the Mobile County Circuit Court. Dated: August 10, 1998

or the Clerk's Office for Information. By Orline Clerk's Office Robert G. Kendall, Judge of the Circuit Court

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NATIONAL GEOGRAPHIC

From the Editor

LIKE MANY of the world's fascinating places, the traditional tomb of Moses' brother Aaron is in the middle of nowhere. Starting out from the ancient city of Petra, I spent six hours under a relentless Jordanian sun, bobbing and swaying atop a camel, to get there. And it was worth every sun-seared second.

Looking down on the barren landscape from atop the mountain called

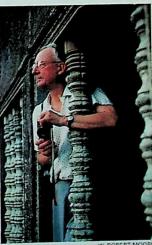
Jebel Haroun (top right), it was easy to imagine myself, guide Hamoudi al-Bedoul, and Don Belt, the author of this month's story on Petra, as the first people to make this journey since biblical times. But at our campsite a few hundred feet below the summit I saw just how wrong such an assumption would be. Carved into the rock was an Arabic inscription: "Fulan, the one who is poor in Allah's sight, comes to this holy place." According to the date, Fulan preceded us to this spot by 688 years.

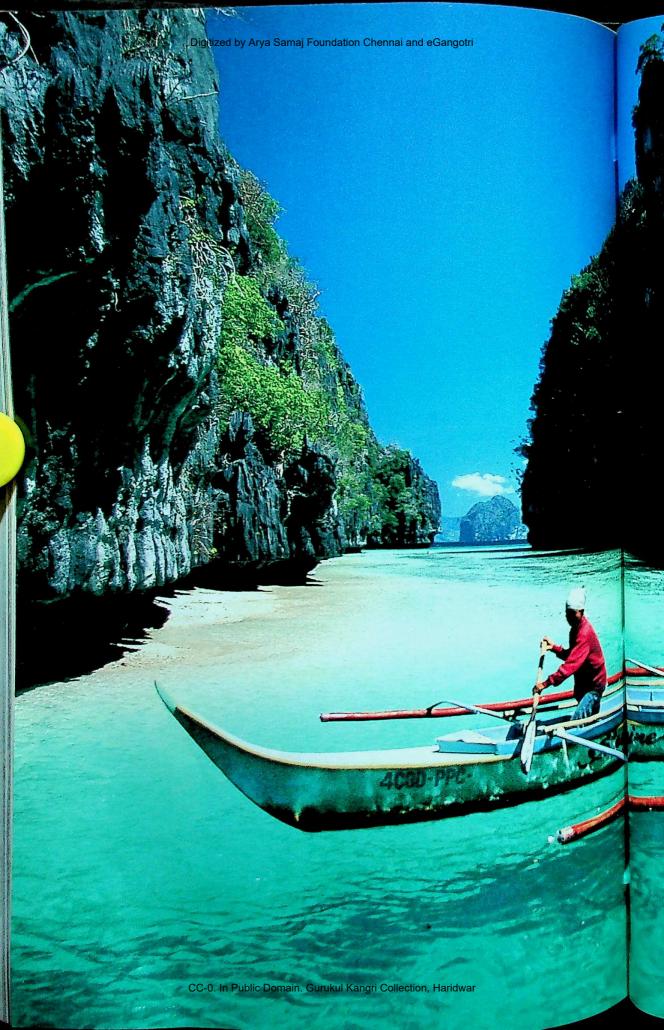
From its earliest years National Geographic has brought the world's most remarkable sites, no matter how remote, to its readers. When Editor Melville Bell Grosvenor visited Angkor Wat in Cambodia in 1959 (lower right), the magazine was pre-Paring one of the last looks at the magnificent temple complex before it was ravaged by war. But armed conflict is not the only threat to such sites. They can also be loved to death by visitors who accidentally break things, wear down fragile structures, or walk off with seemingly insignificant souvenirs.

At the GEOGRAPHIC we sometimes worry that an article about an intriguing, yet fragile site may lead to too many visitors, who will in turn threaten a delicate environment or structure or way of life. That's why, on rare occasions, we may not cite the exact location of a particular subject, like a crumbling cliff dwelling.

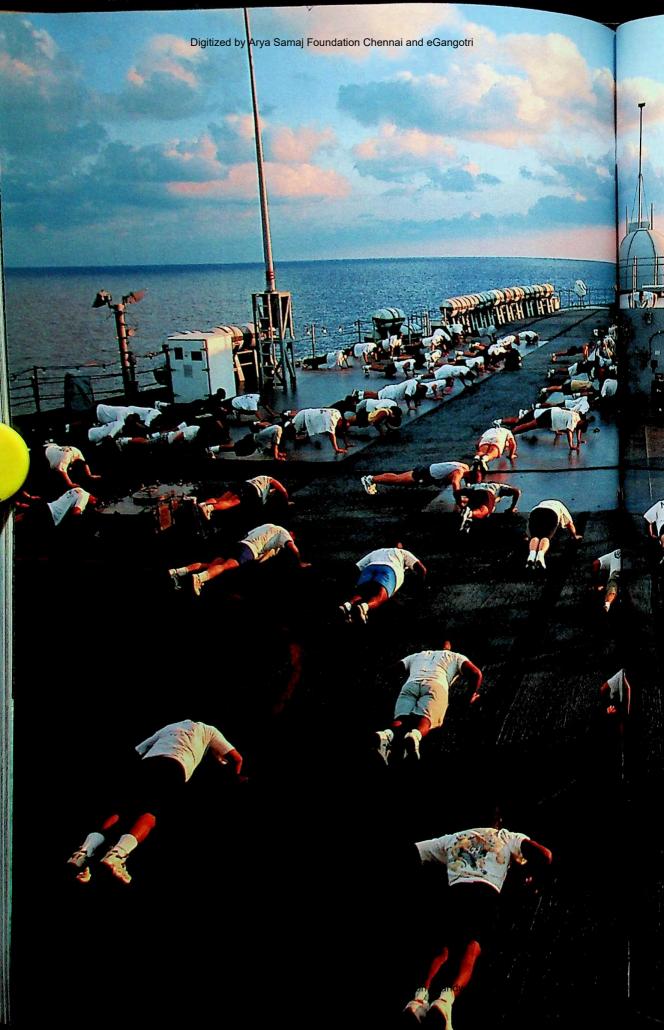
After all, not every threatened site is buffered from civilization by a six-hour camel ride.













fter a long flight over the southeasterly reaches of the South China Sea, the C-130 transport plane banged down on Pagasa atoll in the middle of the Spratly Islands. Getting out to stretch my legs on the crushed coral runway, I could see a clump of spindly trees, a mossy concrete pillbox or two, and then nothing for 360 degrees but dazzling, jet-blue sea.

"This is Armageddon?" I thought, chuckling to myself, as 50 Filipino troops, armed with rifles, sauntered smilingly toward the tree line.

Not that there is anything funny about the Spratlys. Sporadic shooting sprees have left dozens of sailors and fishermen from neighboring countries dead or wounded as their governments vie for control of this scattered rosary of coral specks and sandbars. Officials in both Washington and Beijing peg the Spratlys as a possible trigger for a showdown between the United States and China.

But from Pagasa, a Philippine military encampment since the early 1970s, the Spratlys appeared to me less to augur the end of the world than to occupy it. From atop its battered concrete observation tower the island looked deceptively small, a disk of land that seemed no bigger around than Yankee Stadium, with a sparkling lagoon where huge brains of mottled coral communicated with a shallow bottom. Watching surf pound the thin reef wall separating the turquoise pool from the wild indigo sea, I felt my heart sink a little at the beauty of it all. How could any place this remote be the source of so much trouble?

The answer, in a word, is location. The Spratlys lie along one of the most strategic shipping routes in the world, a deepwater slot that zigzags up the middle of the South China Sea for 1,700 miles from the Strait of Malacca

in the southwest to Hong Kong in the north (map, following pages). Each day some 200 merchant vessels haul oil from the Middle East (including 80 percent of Japan's total supply) and thousands of other riches. Shrimp come from Thailand, rice from Vietnam, Nike sneakers from Indonesia—much of it to stock store shelves in the West. What's more, the Spratlys could harbor sizable untapped oil reserves.

And nations have been willing to fight over this strategic property. Ten years ago a brawl with a Chinese gunboat here resulted in the death of at least 70 Vietnamese seamen. In 1995 the Filipinos went ballistic when the Chinese occupied nearby Mischief Reef and dynamited coral to put up what looked from reconnaissance photos like rickety backyard tree houses. A Filipino naval patrol responded by blowing up a Chinese structure, which brought a request from the U.S. to stop the retaliation before it got out of hand.

The delicate job of keeping this strategic ocean artery open for business ranks high on the U.S. list of global security concerns. But what keeps its big gray-hulled warships on permanent patrol there may increase the risk of a collision among major geopolitical interests. When and if a newly robust China, which claims historical deed to the entire sea, acquires

TRACY DAHLBY has covered Asia as a correspondent for the Washington Post, Newsweek, and the Far Eastern Economic Review. Photographer MICHAEL YAMASHITA calls the South China Sea his favorite place to travel.

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NATIONAL GEOGRAPHIC, DECEMBER 1998

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PAGASA ISLAND, SPRATLY ARCHIPELAGO

Staking a claim, the Philippines built this airfield to carry troops to a speck of land that China, Taiwan, and Vietnam also call their own. The United States pledges not to intervene in the contested Spratlys.

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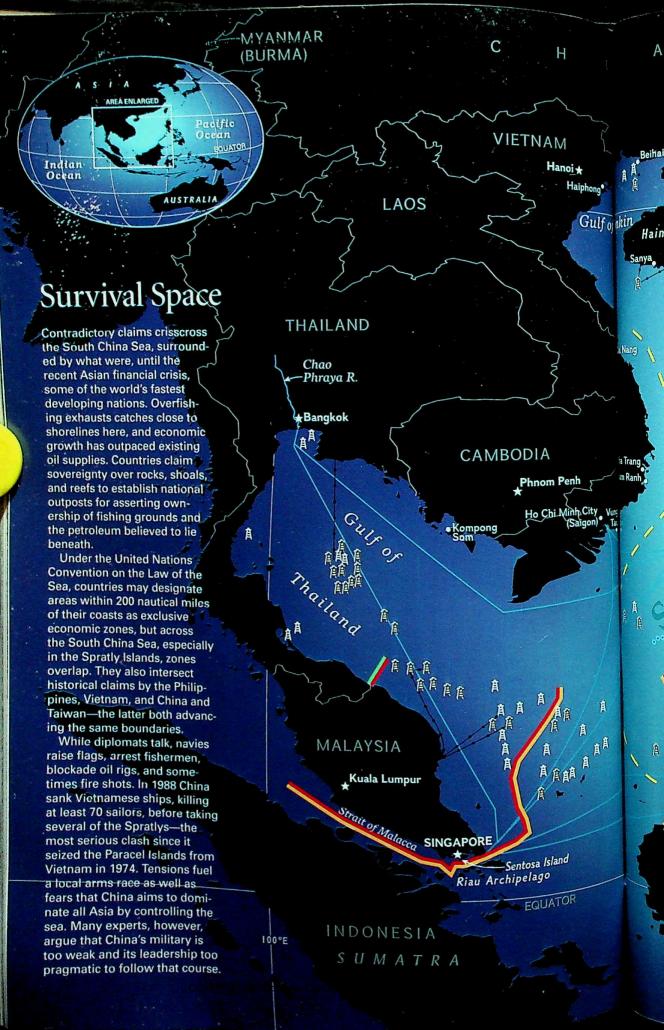
the naval weaponry to enforce its ambitions, will the U.S. be forced to get tough?

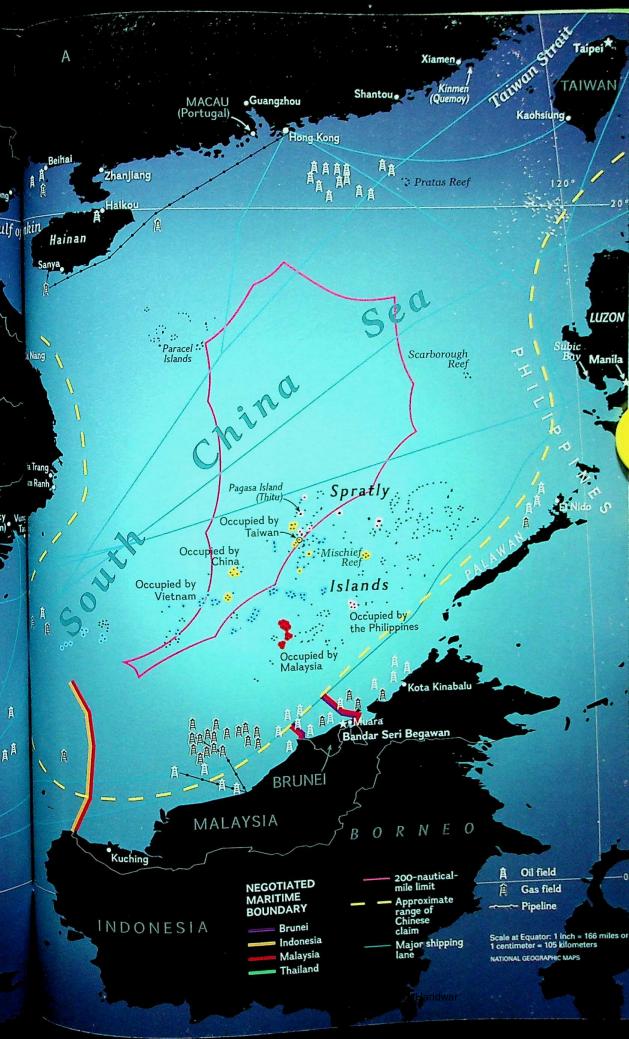
Publicly American officials downplay the potential danger, but privately they worry. "I just hope they don't find oil in the Spratlys," a Navy officer told me.

OR 2,500 YEARS the South China Sea has seen one scramble after another for its limited and valuable resources. Early navigators—Malays, Chinese—braved and mysterious monsoon currents. They

chased the lure of sandalwood and silk, teas and spices, over a no-man's-land of reefs and shoals, establishing its first trading routes. Beginning in the 1500s, European—and eventually American—fortune hunters sailed in, pursuing visions of God, gold, and glory. They were spellbound, as Joseph Conrad put it, by "dark islands on a blue reef-scarred sea." Pragmatic colonial powers meanwhile set up elaborate engines for pumping tin, antimony, rubber, nutmeg, gold, and other natural treasures to the outside world.

Today the old, semi-enclosed sea is more vital to the global economy than ever. Shaped like a hammerhead shark with a weight problem, the 1.4-million-square-mile body of water carries roughly a third of the planet's shipping and could harbor trillions of dollars in undersea deposits of oil and natural gas.





HAINAN, CHINA

With so much up for grabs, the ten Asian nations that crowd the sea's coastline view these waters and its prizes as a source of national pride—and survival. In 1995 the Association of Southeast Asian Nations (which includes all the littoral states except China, Cambodia,

and Taiwan) pledged to "refrain from taking actions that destabilize the region." But as Lee Lai To, former chairman of the Singapore Institute for International Affairs, told me, "no one wants to make any concessions."

Exactly what China intends, meanwhile, is anybody's guess, but there is little doubt about how most Chinese feel when it comes to questions of ownership. During my travels I stood on the bridge of a pitching cargo ship while the Chinese second officer hovered over a nautical chart to give me a geography lesson.

"China owns all of this." His finger looped around the entire sea, including territory also claimed by Vietnam, Malaysia, the Philippines, Brunei, Indonesia, Taiwan, and possibly Thailand and Cambodia.

"What belongs to China's neighbors?" I asked.

"It's China! All China!" he said. His finger marched from the Paracel Islands in the northwest through the Spratlys in the southeast. It paused over a jot of land near Luzon in the Philippines. "This might belong to the Philippines," he mused. "But probably China!"

O GET a firsthand view of this disputed territory, I spent three months hopscotching the region, traveling north to south, down the coasts of China and Vietnam, then east to west, around the horn to Thailand and Singapore. I shuttled between the sea's two great port cities, Singapore and Hong Kong-aboard a Chinese freighter and again as a guest of a bristling U.S. Navy aircraft-carrier battle group. By the time the journey ended, I had viewed a scuttled pirate ship in the milky green waters off Indonesia's Riau islands, survived nerveracking climbs up and down ships' ladders in heavy seas, and tasted the combative spirit with which the peoples of the South China Sea attack their fate.

It began one steamy evening as the sun dropped behind the green cone of Hong Kong's Victoria Peak and I hauled my duffel

The tide is out for the owners of these boats in the city of Sanya. Like many small fishermen, they are left with dwindling catches near shore as larger boats pursue fish with sonar and bigger nets.

bag along the dock toward a boxy cruise liner called the *Star Pisces*. On the bridge Captain Peder Nilsson, blond and gruff, looked radioactive in the gilt-edged twilight as he eased the stern away from the Ocean Terminal. Freighters, hydrofoils, water taxis, ships of every size and type moved in all directions at once as their lights—amber, hot white, and red—streaked the viscous waters.

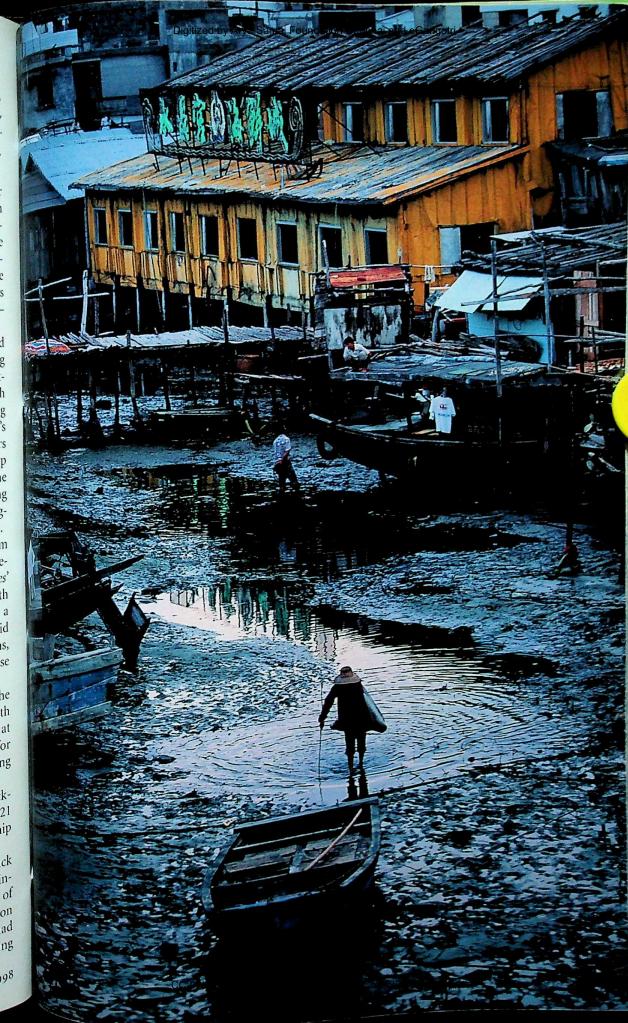
Below him the decks of the *Pisces* throbbed with nervous energy. Layered like a wedding cake, with staterooms, a beauty salon, a night-club, and three casinos, the ship bustled with 1,977 prosperous middle-class Hong Kong residents bound for an island off China's southern seaboard. Squealing teenagers mobbed a fragile-looking Cantonese pop singer. Younger kids made a beeline for the huge video arcade, while grown-ups, pushing their way into the ship's five restaurants, ignored pleas for a "mandatory" life jacket drill.

Such restlessness had helped transform Hong Kong from a desolate rock into the free-market dynamo that now glided past the *Pisces* picture windows, its office towers blazing with light. But now my fellow passengers faced a new element of risk: Four days earlier, amid skirling bagpipes and booming lion drums, they had watched Hong Kong revert to Chinese sovereignty after 156 years of British rule.

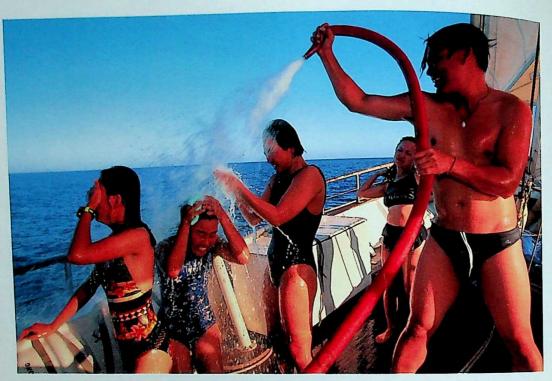
To unwind, the passengers headed for the casinos. In a big L-shaped room furious with sound and motion, they elbowed for space at crap tables, baccarat tables, and tables for games I did not know, slapping down big Hong Kong notes as they went.

"Aiya!" cried a bespectacled matron, smacking her forehead as a blackjack dealer drew 21 to her 18. Undaunted, she inched her last chip forward—then turned up a winning hand.

Such gutsiness paid off for her and struck me as symbolic too. While for 1.2 billion main-landers the British handover was a source of soaring nationalistic pride, the 6.5 million Chinese residents of Hong Kong, who had prospered over the years precisely by not being



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SOUTHEAST OF HONG KONG

Showered with abundance by China's experiments with capitalism, residents of Hong Kong pay \$1,300 each to rough it on an Outward Bound voyage featuring saltwater baths. Ferrying between two of China's laboratories of free enterprise—Haikou and Beihai—workers sleep away a 12-hour journey that costs six dollars—three days' pay at minimum wage.



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Would the new China, now freed from its colonial past, prove a political heavy or an enlightened landlord? ... It was too early to tell....

in China, viewed events with mixed emotions. "When I saw the new flag go up," a Hong Kong businesswoman in her late thirties told me, recalling the ceremonies on TV, "I felt this intense fear deep inside."

Would the new China, now freed from its colonial past, prove a political heavy or an enlightened landlord? Since it was too early to tell, she suggested a strategy: Keep the upper lip stiff, in the British tradition, and a shrewd eye peeled for new commercial opportunity.

on China's Hainan Island, where a commercial gamble of major proportions revealed itself. From the quay the distant city appeared as a gleaming, elongated cluster of big buildings splashed with turquoise and silver light that reminded me of the Emerald City in *The Wizard of Oz.* But cruising the sun-fried streets in a taxi, I saw that many of the structures were weirdly empty—gray skeletons of rusting steel and crumbling concrete, with no glass in the windows.

Such were the ruins left behind by the "overheated economy," Yao Fan, a local economist, told me when I visited him at the city's Expert Building. Problems grew when Hainan was declared a special economic zone in 1988. With few rules to regulate commerce, the island attracted freebooting foreign investors, mainly from Hong Kong and Taiwan, who pumped cash into real estate and even planned a Club Med. But when the speculation had run its course, ornate but unsellable resort condos littered the palm-fanned coastline, and Hainan was hit by bankruptcies, unemployment, and rising crime.

Yao was willing to bet that once the Chinese exercised greater control over Nanhai, as they call the South China Sea, with its oil, natural gas, and fish, their troubles would be over. Hainan, China's smallest province, became its biggest when the South China Sea was included. "Our exploitation of Nanhai resources," he explained with pride, would in turn help

China "regain control" of its historical domain.

His passion for Nanhai, understandable from the Chinese point of view, struck me as ironic. During the Ming dynasty (1368-1644) traveling there had been a capital offense. It was only when rulers ran low on incense and other luxury imports that an intrepid eunuch, Admiral Cheng Ho, set sail on a series of voyages (1405-1433) that passed through Nanhai to India and Africa. But as John Miksic, an archaeologist at the National University of Singapore pointed out, imperial China set up no official trading centers in Southeast Asia. Later "they burned their boats and hemmed themselves in," says Miksic.

Such arguments undermine China's sweeping claims in the eyes of many non-Chinese, but they cut little ice in China, where more than a billion people with rising free market expectations refer to Nanhai as *shengcun kongjian*, or "survival space."

ways of defining survival are themselves undergoing revolutionary change. I discovered this on board to the Old coastal city of Beihai. Next to me at the rail was a grinning young man in a flamboyant sport shirt.

"I like Hollywood movies!" he volunteered.
"I like Arnold Schwarzenegger!"

Then, moodily: "America has two big oceans! That is unfair!" As if in agreement, the South China Sea walloped the creaky hull, dousing us with spume.

"China was a great country but became weak," the man plunged on. "We need money! We need Taiwan! We should take it!"

But when I raised my eyebrows (it was little more than a year since China had lobbed missiles toward Taiwan in military exercises suspiciously coinciding with presidential elections there and putting U.S. Navy aircraft carriers on alert), he added, "But it won't happen."

Looking out over the darkening waters,

XIAMEN, CHINA

Tending to their own businesses, oyster farmers in Maluan Bay gultivate private profits. China's pursuit of "market socialism" has spawned similar opportunities in Xiamen, the special economic zone on the horizon, where workers compete for attractive jobs in Taiwanese-owned factories.





where a string of illuminated squid boats began to flash in the night, my friend grew gloomy. "I hate the communists!" he said.

Having reported from China in darker times, I looked over my shoulder to see if anyone was eavesdropping. But few people seem concerned about the party line. In the new China citizens were wheeling and dealing with the gutsiness I saw earlier in Hong Kong. Another young passenger explained how she had gone from selling black-market gasoline to selling sea snakes. She bought them in Beihai and sold them in Haikou for a tidy profit. Her dream was to get ahead of intensifying local competition by marketing Nanhai products in Beijing. Something as exotic as sea snakes, I suggested, might make a splash in the faraway capital.

"Do you think so?" Her face illuminated in stages, like a three-way lightbulb. "Or coconuts!" Click. "Or mangoes!" Click, click.

ARTHER SOUTH, Vietnam has equally big economic dreams. Things would go much more smoothly there if only Bien Dong, or the East Sea, as the Vietnamese call it, would yield more oil. Disputes with China over offshore drilling rights have hampered Vietnam's efforts to turn its communist past into a more open-market future. But the real problem is that years of costly exploration have produced exasperatingly little oil.

"It all boils down to luck, luck, luck," said Quang Le, Mobil Oil's chief representative in Vietnam, as we rode a helicopter out into the south Con Son Basin, 190 miles southeast of Vung Tau, Vietnam's major oil and gas port. On the drilling deck men in hard hats and greasy overalls wrangled lengths of pipe down the drill shaft amid a noise that sounded like prehistoric animals fighting for turf.

When a gusher of mud blurted out, the men danced away, laughing and shouting. After only four days of drilling, Quang explained, they were 2,600 feet below the seabed, with 10,400 to go and 56 days left on an 11-million-dollar drilling contract to get there. "It's once down, once to the side," said Quang. "Find out what we have and we're out."

The rig had a fantasy-camp wildness about it that appealed to me. The crew—mainly the Europeans and the Filipinos—wore fantastical

walrus mustaches, tattoos, and flowing, shoulder-length hair. When I asked what had attracted them to life on the rigs, they said that it was the good wages and the adventure. "The economy in Vung Tau goes up a few notches when we hit the bars and open our wallets," said one Australian with a gap-toothed smile.

Despite difficulties in the search for fossil fuels, plenty of dreams do pan out in the South China Sea. In Singapore I met Dorian Ball, a South African salvage diver, whose tortuous six-year search for sunken treasure on the Diana, a British sailing ship that went down near the mouth of the Strait of Malacca in 1817, nearly wrecked his personal life and finances, until he finally found the ship and its 3.5-million-dollar cargo of Chinese porcelain. In the Philippines I met Richard Gordon, a local politician, whose vision turned the abandoned U.S. Navy base at Subic Bay-once famous for brothels and clip joints-into a burgeoning special economic zone that has generated thousands of jobs, a billion dollars in foreign investment, and enough public acclaim that, when we spoke in Manila, Gordon was considering a bid for the country's presidency.

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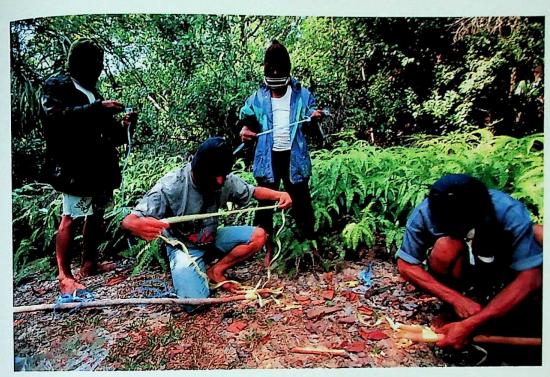
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SOUT

point, when the fabric of romance refuses to stretch over the day-to-day realities of travel. Mine arrived midjourney, in Bangkok. A ship that would have fetched me to Singapore had burnt to the waterline and sunk. Lead gray and carinfarcted, the city, its infamous bars decorated with Christmas lights in July, held little glamour for a marooned, middle-aged hack.

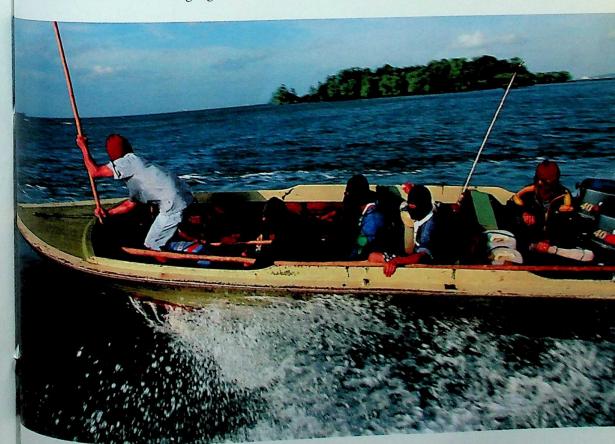
I decided to hire a fishing boat to take me down the Chao Phraya River where it empties into the Gulf of Thailand. Maybe I could find the spot where the captain in *The Shadow-Line*, my favorite Conrad tale, his ship fatefully becalmed, falls prey to deadly currents that move, mysteriously, "with a stealthy power made manifest by the changing vistas of the islands fringing the east shore of the Gulf."

As if from central casting, my skipper, Somsak, steered his crumbling red-and-white craft down the Chao Phraya. He sat cross-legged on the engine cowling, a gnarled big toe—its nail opaque as a shrimp cracker turning the wheel. To my delight the clutter of factory chimneys, cargo cranes, and



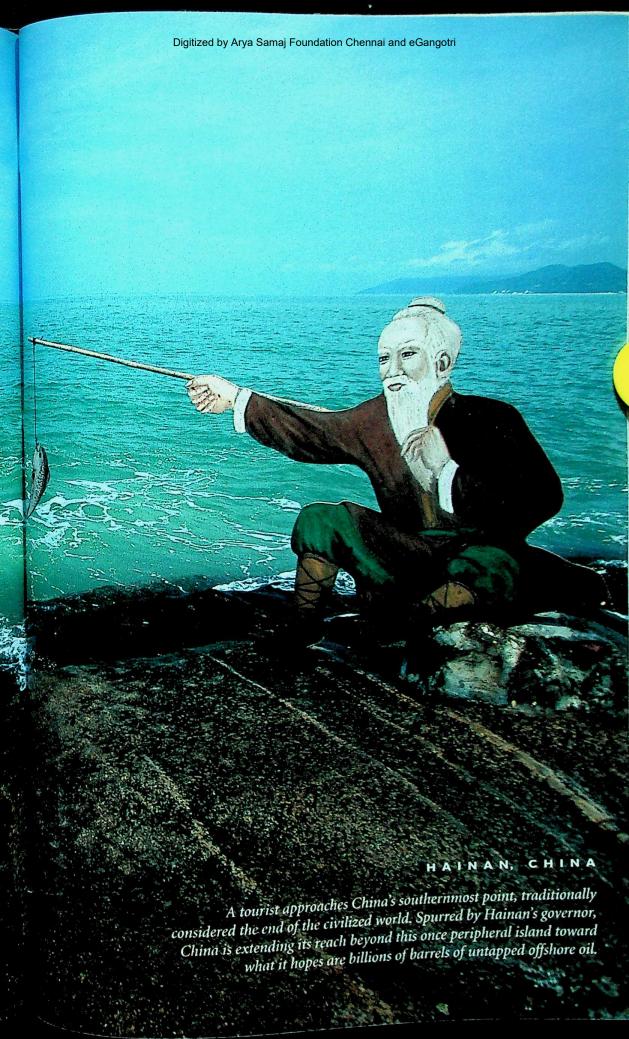
RIAU ISLANDS, INDONESIA

Hiding out near Singapore, pirates fashion hooks to board ships (above). When darkness falls, they will zoom close on a speedboat (below), board over the stern, and, armed with knives, rob the crew. As the American and Russian naval presence in Southeast Asia has declined, pirate attacks have soared: Some gangs steal whole tankers with the help of corrupt local officials.



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SENTOSA ISLAND, SINGAPORE

Under a captive bounty, visitors to Underwater World (above) gaze at marine life of the South China Sea, source of a tenth of the world's annual ocean harvest. In Taiwan's main harbor (below) a refrigerator ship unloads tons of fish caught off Indonesia and frozen for transport. Experts warn that too many boats are chasing too few fish for such catches to continue.



KAOHSIUNG, TAIWAN CC-0. In Public Domain. Gurukul Kangri Collection, Haridwar

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Now too many fishing boats and toxic runoff from factories and shrimp farms have depleted what was, until only recently, one of the world's most abundant fisheries.

steel-hulled warships riding at anchor opened to reveal glimpses of the "great gilt pagoda" at Paknam and other landmarks from the time Conrad knew the river a hundred years ago.

"Ah, the romance," I thought, my mood soaring.

Somsak, who didn't know Joseph Conrad from Conan the Barbarian, alerted me to a special buying opportunity: His friend, right around the next bend, just happened to have a catch of fresh lobsters for sale.

"No lobsters," I said.

Somsak chuckled piratically at my refusal as the wind kicked up and we juddered through mud-colored waves like an eggbeater in a bowl of gravy. Minutes later, he pointed a finger, alluvial with grime, toward pincer-like headlands that crimped the channel, shouting, "That is the outer bar!"

With a sidelong glance Somsak said, "The lobsters are very delicious."

"No lobsters," I said.

But I couldn't blame him. In his late 40s, he had spent his life fishing in the gulf. Now too many fishing boats and toxic runoff from factories and shrimp farms have depleted what was, until only recently, one of the world's most abundant fisheries.

"The gulf is basically finished," Wicharn Sirichai-Ekawat, chairman of the National Fisheries Association of Thailand, told me when I met him in Bangkok. "We're trying to reduce the number of boats, ban certain types of fishing, protect areas for reproduction and spawning," he said. But he thinks such measures will slow the decline at best.

To survive, Thai fishermen now venture farther and farther out, into waters claimed by Vietnam, Indonesia, and Burma. Some have died in shoot-outs with border patrols, and many more languish in jails around the region.

Somsak, too, had harbored dreams of filling his boat with Vietnamese fish. "We got within 50 miles of the coast when we got caught in radar," he said, recalling his brush with a border patrol there several years ago. "We tried

to get away, but our engines overheated. So we took the ice off the fish and threw it on the engines to cool them down!"

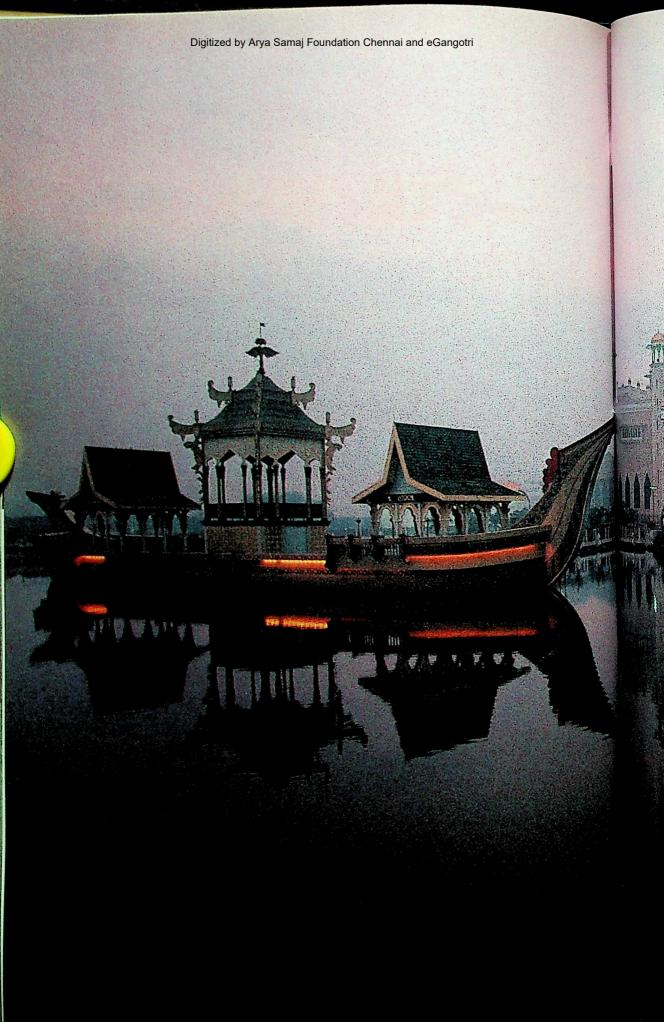
How had he escaped? Somsak tapped his temple. "We steered for a slower boat, and the Vietnamese caught them instead!"

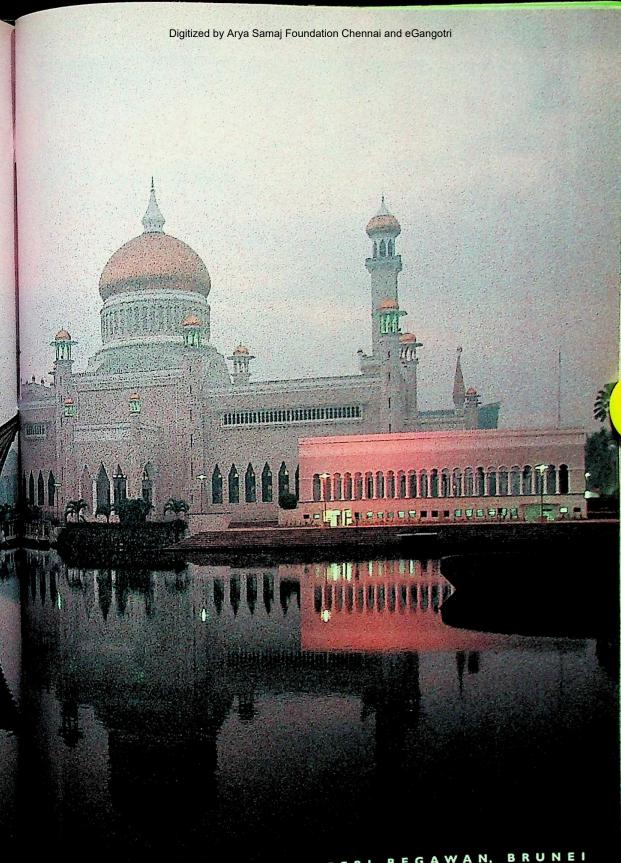
Such cutthroat competition is spreading throughout the region as fish stocks dwindle and prices go sky-high. "The sea is already being fished at more than twice the level it should be," said John McManus, a marine ecologist I met in Manila. "Perhaps half its reefs have been damaged by fishermen using cyanide to stun fish or dynamite to kill them."

HE ANCIENT PRACTICE of piracy is one industry that isn't suffering in the South China Sea, where, in 1997, 105 of the 229 shipboard attacks reported worldwide took place. Today's sea robbers use speedboats, radar, and ship-to-shore radios but still rely on the time-tested element of surprise, zipping from hidden coves to hit cargo ships as they navigate tricky passages. Most stop at thievery, grabbing cash from the captain's safe or stealing videotape recorders, personal computers, or other luxury goods from the hold. But there is occasional violence. In an incident off Singapore shortly before my arrival there, a distraught crew, still reeling from attack, hurried to their master's cabin to find him, according to one report, "bound hand and foot . . . dead with a gaping bullet hole in his head."

So it was with reduced zeal that I found myself the lone American on board the *Pacific Mercury*, a 50,000-ton Chinese bulk carrier, as it rode at anchor far out in the Singapore Strait, taking on fuel as the sun went down. Sitting across a table from me were Captain Lu Xun Kun, who shuffled papers, setting his chop to various official documents, and a boarding agent with puffy, bloodshot eyes. "There was a vessel just like this one off Singapore six months ago," the agent said in hushed tones.

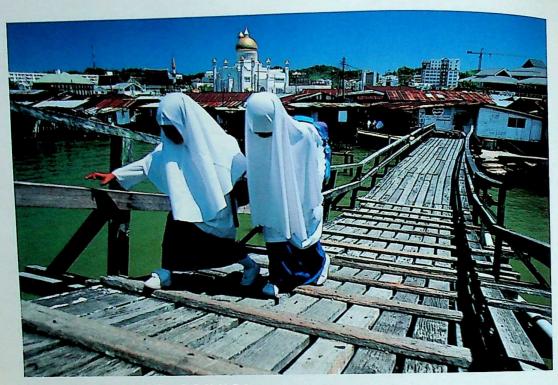
"We finished bunkering her in the evening,





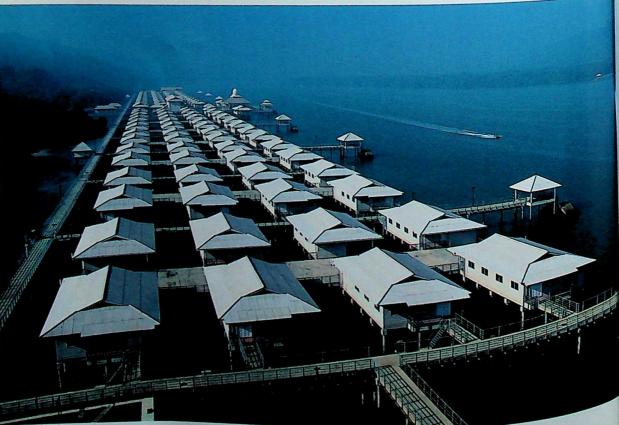
RANDAR SERI BEGAWAN, BRUNEI

State-owned oil raised the gold domes and granite minarets of Omar Ali Saifuddien mosque in this delta capital and lifted the country's per capita income to among the world's highest. Now, eyeing his neighbors' faster growth, the ruling sultan is encouraging private enterprise.



KAMPONG AYER, BRUNEI

Two girls walk home from school in "water village" (above), where 10 percent of Brunei's 300,000 citizens live in houses erected over rivers. If residents lose their homes to fires, they may move downstream to government-subsidized housing (below), part of a welfare system that helps the royal family stay in power but is financed by a diminishing supply of petroleum.



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NATIONAL GEOGRAPHIC, DECEMBER 1998

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just about this time," he said, giving me a searching look. Two hours later, he said, "she was boarded by pirates.

"That ship was going to Hong Kong too."

When that stirred no reaction, he said: "You know, pirates like these big carriers when they're fully loaded because they're so low in the water" and easy to board.

Captain Lu, a steely product of the China ports, raised his head from his paperwork. "Meiyou!—No pirates!" he said, with a sweep of his hand. "If anybody tries to board, we'll hose 'em off!"

When we sailed that night in near-total darkness, Singapore was a wafer of light on the far horizon. On the bridge the big radar screen emitted a greenish glow, reflecting the face of the *Pacific Mercury*'s watchful master. Fore and aft, spectral plumes of water looped over the side—the fire hoses going full throttle to keep pirates at bay.

Locking myself in my cabin, I consulted my copy of *Pirates and Armed Robbers: A Masters' Guide*. Sure enough, fire hoses were an approved but not foolproof antipiracy precaution. If pirates did manage to board, the manual advised: "Don't be heroic—[they] may be armed."

The night passed without heroism becoming an issue, but next morning the look on the chief officer's face signaled fresh peril. "Typhoon developing here," he said, in halting English, pointing to a weather map curling off the ship's fax machine. From the panorama of the bridge, the skies sparkled like polished chrome, but it was late July now, typhoon season, and a disturbance named Tina, with winds whipping toward a hundred miles an hour, was headed our way.

"My vessel moving here," said the officer, his "typhoon" hand converging with his "ship" hand at a point south of Hong Kong. It was in that vicinity, in 1835, that Thomas Jefferson lacobs, an officer aboard the American clipper ship Margaret Oakley, glimpsed the beast the Cantonese called tai feng, or big wind. "A terrible crash was heard!" he wrote. "The vessel trembled like an aspen-leaf... with the sea Pouring in over the bow, and the topsails shivering like so many rags."

Thankfully, modern radar makes typhoons telatively easy to avoid. Tina spun harmlessly up toward Japan. Typhoon Victor clobbered

Hong Kong, causing mudslides and death, but left us alone.

"Everything's gone space-age," said Captain Duncan Tefler, when I visited the Hong Kong offices of the China Navigation Company, Ltd., a proud old name in the region's nautical past. A voluble Scotsman, Tefler directed piercing blue eyes at the large V-shaped room beyond his glass cubicle, where technicians leaned into computer screens, as into a stiff wind. They were keeping tabs on company cargo vessels by means of e-mail that whistled back and forth through the circumambient cyber seas.

"Gone are the days," said the former steamer captain, "when ships could disappear and the master report to the owners once a year."

Rankine aren't impressed by such innovations. That was obvious the night I prepared to leave Muara in the tiny Islamic sultanate of Brunei on Borneo's serrated northern coast. I stood at the rail of Rankine's freighter, the M.V. Straits Star, listening to him cluck his tongue at the slow stevedores, impatient to get under way for our run to Kota Kinabalu in East Malaysia.

"Restrictions! Paperwork! You don't have time to train people!" he grumbled. "Oh, there is no romance left to this sea life!"

Rankine, a tall, bluff Eurasian in a crisp white uniform shirt with gold braid, had been on the China Sea for 43 years. In lilting English he recalled for me the days when his employer, the Straits Steamship Company, had been the seaborne railroad of empire. Ships with teakwood decks carried live monkeys, orangutans, and snakes in the hold, British grandees in first class, and servants in steerage. "Oh, there were famous storms," Rankine crooned, like the one that chased him from Borneo to Singapore 25 Christmases ago, keeping him 57 hours on the bridge.

In the nail-biting days before commercial vessels routinely carried global positioning systems, Rankine had sailed from Bangkok to Borneo as first officer on a ship blinded by bad weather. "I went below for dinner when we synchronized with a swell," he recalled. "One, two, three—the portholes were in the water! All lifeboats broke loose." Rankine's fleshy hands flew apart, signifying total chaos. What happened? "We altered course and reached





Singapore safely," he said nonchalantly, adding that a crewman blamed the captain for almost getting everyone killed and went after him with an ax.

"Passenger service was killed off by airplane travel," said Rankine. Then, three decades ago, container cargo came along, making sea transport cheaper, faster, and more efficient by packaging goods in

and more efficient by packaging goods in waterproof, tamper-resistant steel boxes that can be quickly loaded and unloaded. That saves labor costs and prevents theft and damage but also cuts days once spent in exotic ports of call to only hours. Gone are the ships with magical names—the old M.V. *Rajah Brooke* and the S.S. *Kajang*—the seven-course breakfasts, and the men who stuck with a ship for 20 years or more.

"Oh, there are no real seamen left in this world," Rankine said, waving his hand. "Everything is in the books, not in people's heads!"

Rankine, anxious to get out of port, shouted "Where's that pilot?" into his walkie-talkie. In a flash a small, petrified man was on the bridge deck, bowing ferociously and offering excuses in Malay. "He doesn't want to take her out," snorted Rankine. "Pilots today have no experience," he muttered, preparing—not unhappily, it seemed to me—to do the job himself.

"Oh, the last of the Mohicans!" cried the old captain, as the 258th container swung over the side and banged into place and he was finally free to head his ship for the Brunei cut and the darkness of the open sea.

TUCH ADVENTURES appeased the eternal adolescent in me but made my inner reporter skeptical. By my third call at Singapore, where I waited for a final run up to Hong Kong on the aircraft carrier U.S.S. Constellation, I had concluded that the glory days of Conrad were pretty much finished. With its mix of Chinese, Malays, and Indians, Singapore was full of "the glitter, the colour of an Eastern crowd" that the old master had described-women in saris of red and purple silk or hooded in black Muslim chadors, men wearing turbans or laced prayer caps. But more than anything the city-state resembled a shipshape Los Angeles, with immaculate sidewalks lined with McDonald's, Häagen-Dazs, and Toys "R" Us.

I was also having serious doubts about the idea that a rising China might use military

CAM RANH BAY, VIETNAM

Women swaddled against the sun paddle ocean water into ponds where it will evaporate, leaving salt behind. Plans call for increasing such production by half, so Vietnam can have a new export.

force to turn the entire South China Sea into a national lake. For one thing, the U.S., which patrols the sea like a cool-eyed town marshal, takes a dim view of anybody who might obstruct the free flow of maritime traffic through international waters.

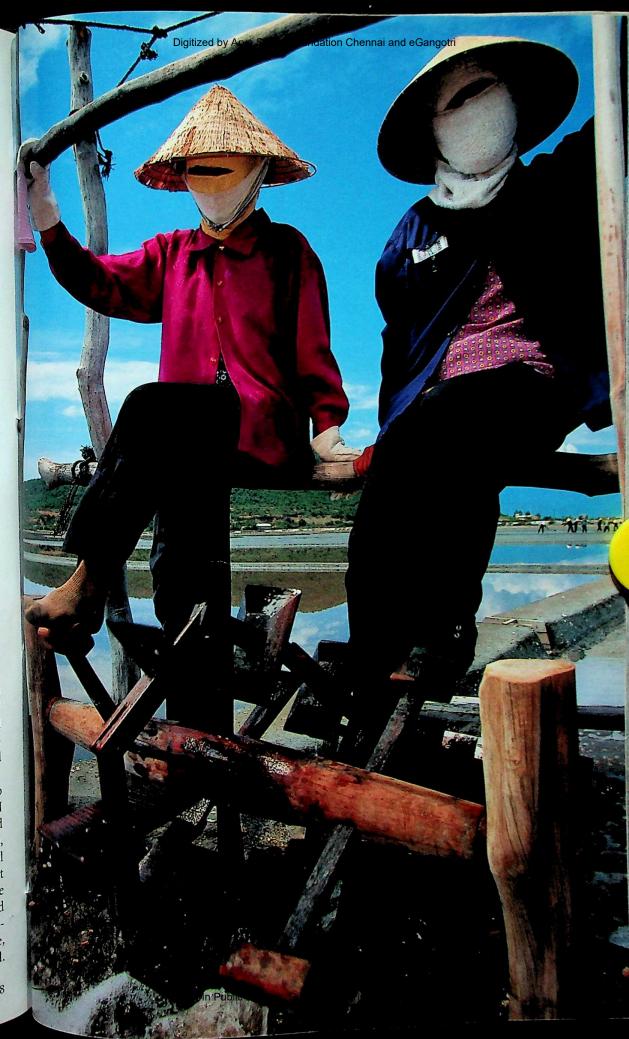
That was the situation aboard the Constellation when I stood on the bridge with Capt. Rocklun Deal, watching a jet fighter scream off the flight deck every 90 seconds, laying a trail of exhaust fumes over the sundown waters somewhere to the west of the Spratlys.

With 4,700 souls on board, the carrier seemed more densely packed than my neighborhood in Manhattan. Walking through the bulkhead doors, lined up in diminishing perspective down the side of the long, gray hull, was like walking toward a mirror. The effect was disorienting to me, but Captain Deal knew exactly where he was going.

"Technology lets us survey the airspace out to hundreds of miles and tell who's friendly and who's not," explained Deal. That would come in handy if China ever did flex its military muscle. So would America's huge material edge: The U.S. outguns China in aircraft carriers (12 to 0) and ballistic submarines (18 to 1), as well as in most sea fighting basics.

Suddenly a disembodied voice from the ship's Combat Defense Center belowdecks reported: "CNN aircraft declaring emergency." A news helicopter, presumably American, had wandered into a potential showdown over "disputed islands" between countries code-named "purple" and "orange."

But this was a war game, not a real war, so the Navy would not be forced to get involved. I wanted to know if one of the color codes stood for China. Offering me a chocolate chip cookie, Deal said they stood only for hypothetical antagonists. I understood his reticence: What could be gained from fingering China as the potential bad guy? Diplomatic talk, backed by the admonitory presence of technology packed mountains of steel like the Connie, might well solve any crisis before it started.



"What people want here and on the mainland is the same thing—economic progress. . . . Governments should listen to the voice of the people."

Moreover, it wasn't at all clear how eager the American public would be to prosecute a war in a place that few voters—even educated ones—could readily locate on a map.

But I didn't give up. The next day I flew off the decks of the Connie with Vice Adm. Bob Natter, commander of the U.S. Seventh Fleet. The eyeball-popping impact of g forces that crushed us into our seat cushions as the Connie catapulted our aircraft out over the sea was not conducive to conversation. But over breakfast in Hong Kong, when gravity had returned to normal, I asked him how he assessed the Chinese threat.

Natter, a lean, handsome man who fought as a Navy commando in Vietnam, thought for a moment as he buttered his toast, then said that it stood to reason "the Chinese will try to impose their influence on the region"—just as the U.S. tries to "impose our will out here too." But he wanted to be optimistic. "China has the economy as priority one," he said. "It's in their interests to maintain stability."

Natter's biggest worry was Taiwan, and China's insistence on seeing the island of 21 million reunited with the motherland. He hoped that peaceful evolution, not confrontation, would resolve the issue. "I'd hate to see two powerful militaries get involved there," he said, "because then we'd have to get involved too."

ALK OF A POSSIBLE SHOWDOWN in the Taiwan Strait reminded me that my mental picture of the China seas had not been molded exclusively by Joseph Conrad. One of my most vivid memories rises from the Cold War autumn of 1958, when the U.S. drifted close to war there.

Mao Zedong had threatened to invade Taiwan, but when the Eisenhower administration sent in the Seventh Fleet and hinted at the use of the atomic weapon, the Great Helmsman had settled for shelling the bejesus out of tiny Quemoy, a Taiwanese possession hard by the mainland. A third-grader at Brighton Elementary School in Seattle, Washington, I had

done my bit by fetching two slightly dented cans of Chef Boyardee spaghetti to a PTA food drive for Quemoy's beleaguered children.

As my journey drew to a close, I flew to Quemoy, or Kinmen, as it's now known, where by chance I met one of those children, now a taxi driver named Chen Kuo-chuo. A rugged man of 47, with closecropped black hair and aviator sunglasses, he drove me to the labyrinthine tunnels where he had cowered under that long-ago autumnal fusillade, sustained in part by relief packages from the U.S. ("No spaghetti, thank heavens!" he joked.)

But even as we stared into the bluey haze where, 3,000 yards ahead, rose the green hills of the place we had both feared as Red China, old Cold War currents seemed to be dramatically reversing themselves. Chen, some of whose ancestors left the mainland centuries ago, said

that relaxed restrictions on travel from Taiwan to the mainland free him to visit relatives in Xiamen, today a thriving port. Meanwhile fishing boats smuggle peanuts, pistols, VCRs, and watermelon seeds across the narrow channel. And soon freighters may well travel directly and legitimately—between the two sides.

"The communists aren't like before," explained Chen Suei-chai, Kinmen's first popularly elected mayor, when I sat with him at city hall sipping a cup of jasmine tea. A group of high-powered consultants from Taipei lingered at one end of the big room around a wall map of the Taiwan Strait. Heady talk was circulating among Taiwan's savvy capitalists about the emergence of "China, Inc.," a bloc made up of China, Hong Kong, and Taiwan that, old political barriers notwith standing, might in the new century lead the world and exert a strong pull—political as well



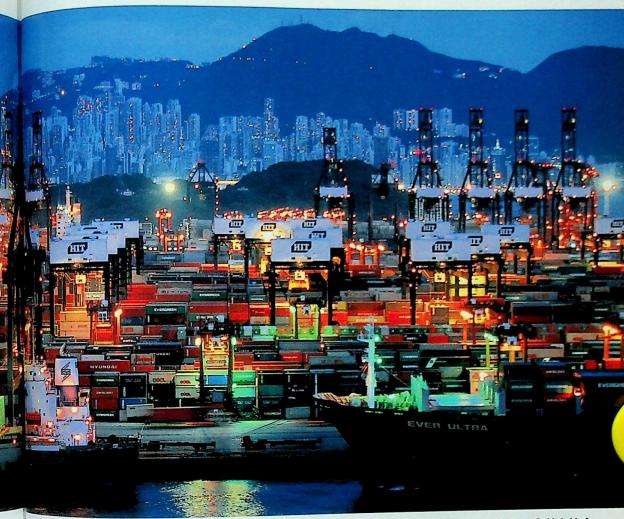
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NATIONAL GEOGRAPHIC, DECEMBER 1998



HONG KONG, CHINA

Lit up like a show window, a port displays goods risk-taking entrepreneurs sell the world at huge profits. Renewed boom times in the South China Sea will require regional cooperation as much as cutthroat competition.

as commercial—all along the rim of the South China Sea.

"What people want here and on the mainland is the same thing—economic progress," insisted the mayor, a formal man in a luminous sharkskin suit. "Governments should listen to the voice of the people."

Mayor Chen pumped my hand and thanked me for coming: "We still remember your kindness in sending that canned food!" Frankly, as I stood there, clutching a plastic artillery shell I had bought, a replica commemorating Mao's famous pounding of Quemoy, I was a little sorry I had mentioned that part.

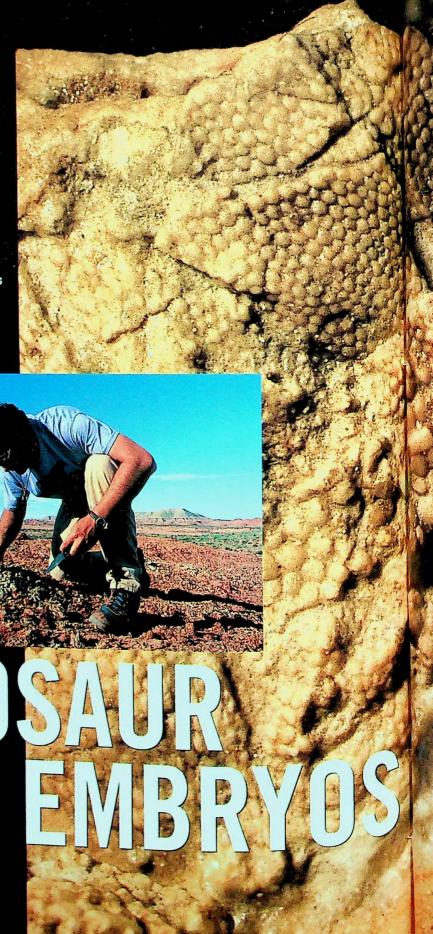
"Yes," teased city official Li Si-heui, "we'll look for the guy who got your spaghetti!"

But as I left city hall and walked toward the sea, my shoes sticking to asphalt sproingy with heat, the kid in me felt badly let down: I mean, the China seas seemed to be well on the way to being annexed by the Home Shopping Network. Was romance completely dead?

Hopping a cab, I headed for the island's spartan airfield. Meditating on the waters of the strait, which shimmered in the late afternoon sunshine, the reporter in me had a small epiphany: However devoid of old-time swashbuckle, this eagerness to embrace the global economy, with its successive waves of consumer goods, was the latest but surely not the last of the mysterious forces to swirl through a sea of unruly, complicated dreams. Where, I had to wonder, would they carry so many tough, contentious dreamers?

By LUIS CHIAPPE Photographs by BROOKS WALKER Art by MICK ELLISON

More than 70 million years ago this square inch of skin covered part of an embryonic dinosaur, perhaps its spine, as it lay in its shell. My team made the astonishing find in an Argentine landscape (below) rife with eggs and embryos, where I search for more of these rare pieces to prehistoric puzzles.



UNSCRAMBLING THE PAST IN PATAGONIA



Walking on Eggshells

n the second day of our search for fossils in a corner of Patagonia's vast Río Colorado formation (bottom right), team member Carl Mehling handed me a porous gray rock. I realized immediately that I held a dinosaur eggshell. It turned out to be one among thousands strewn across nearly a square mile and layered in mudstone 16 feet deep.

As we explored the site, we were less stunned by its immensity than by its rari-

RESEARCH PROJECT

Supported in part by your Society

ties. It has yielded the first embryonic dinosaur skin, the first dino-

saur embryos found in the Southern Hemisphere, and the first eggs that, because they contain embryos, can conclusively be identified as sauropod, a group of long-necked, elephantlegged dinosaurs.

The site—christened Auca Mahuevo after the area's volcano, Auca Mahuida, and its glut of eggs, or huevos—is 55 miles from the nearest town and is as rough as it is remote. "There's no water, no shade," says my colleague, Argentine paleontologist Rodolfo Coria. "Just us, the

LUIS CHIAPPE is a paleontologist and MICK ELLISON is a senior artist at the American Museum of Natural History in New York City. This is photographer BROOKS WALKER'S first assignment for NATIONAL GEOGRAPHIC.



badlands, and, if we are lucky, a dinosaur coming out of the ground."

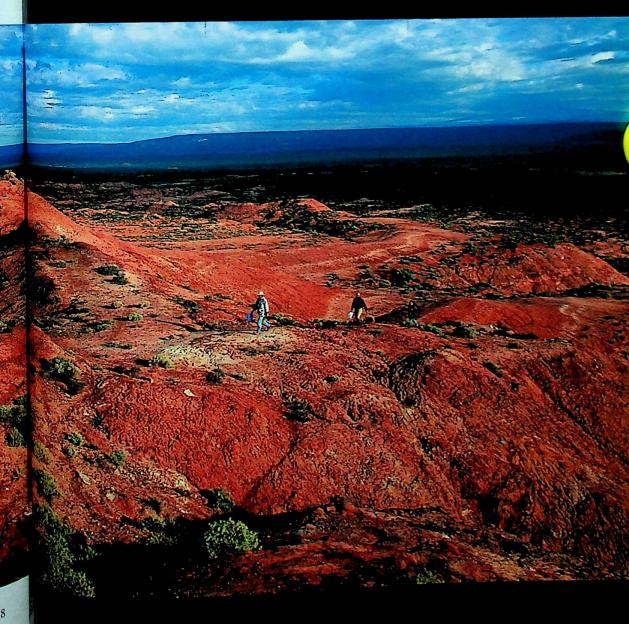
At Auca Mahuevo, our 12-person team has had the kind of luck most paleontologists only dream about. In the hillside quarry (above), Coria, at right, field technician Pablo Puerta, at left, and I unearth whole eggs, carefully opening the shells to reveal tiny embryos.





On the surface, shell fragments are so abundant that we can hear them crunching under our boots. Eons of wind and rain have swept away the soil surrounding the top layer of shells, exposing them (right). "The eggshells are just sitting there saying 'turn me over, look at me,'" says photographer and amateur fossil hunter Brooks Walker. Thus far, for unknown reasons, only the eggs on the surface have held traces of skin, adhering to the insides of the shells.







Preservation and Preparation

life-size illustration shows what the embryos found at Auca Mahuevo may have looked like as they grew. Their skin was scaly, like a modern-day lizard's, and they may have had nasal openings at the top of their heads, as some adult sauropods did. The thin eggshells, five to six inches in diameter, have airholes like chicken

eggs, permitting an exchange of gases that allowed the embryos to breathe.

Early evidence shows that the embryos may have perished in a flood that quickly buried the eggs in a layer of silt and mud. This made it possible for the soft tissues to fossilize before decaying, an extremely rare occurrence.

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To protect the fragile eggs, we coated both single specimens and egg clusters in plaster that hardened into rigid jackets. Then we hauled them by truck from Auca Mahuevo to the Carmen Funes Museum in Plaza Huincul, about 130 miles away. Safely delivered, the egg clusters became the responsibility of museum preparator Sergio Saldivia (right), who painstakingly scraped away clay and silt.

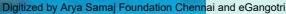
My work with fossils has taught me that without the right specimen preparation you can lose a lot of information. In fact, I couldn't see the eight embryonic teeth preserved in one of the eggs we brought back to the United States (below, in a highlighted grouping above the point of a common pin) until Marilyn Fox, a preparator at Yale University's Peabody Museum of Natural

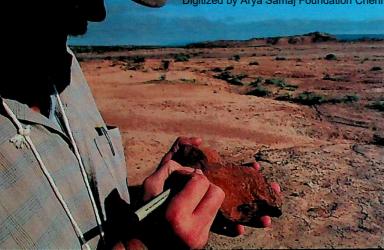
History, had spent about 40 hours cleaning the fossil. The teeth, each less than a tenth of an inch long, provide the most persuasive evidence that these dinosaurs were probably titanosaurs, a farflung subgroup of sauropods.

Most sauropods had wide, spatula-shaped teeth, but a handful had thin, pencilshaped teeth like those found at Auca Mahuevo. Among this group, titanosaurs stand out because they are the only sauropods found thus far in the Río Colorado formation and they are the only ones known to have lived during the late Cretaceous, a geologic period that spanned about 32 million years, including the time when these eggs were laid.









Reconstructing Past Habitat

his is what paleontologists live for, walking into an area that's never been prospected and finding it littered with extraordinary fossils," says paleontological geologist Lowell Dingus (above). He pens reference notes on a rock that he will test to find out how old the site is. Previous dating put it at 89 million to 71 million years old. However, through paleomagnetic analysis, which determines if a rock formed when Earth was magnetically oriented to the North Pole or the South Pole,

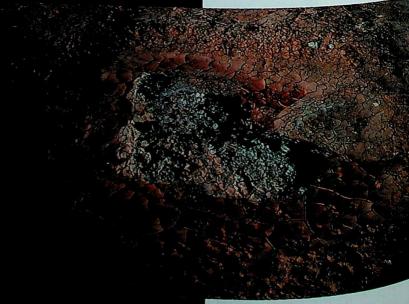
Dingus hopes that he can narrow the range by about six million years.

The rocks also give us a rough idea of how these badlands looked during the late Cretaceous. Egg clusters, like the nearly five-foot-long grouping below, rested on a gently sloping floodplain (opposite). In some years streams probably topped their banks, drowning the embryos. In other years the dinosaurs survived to become hatchlings about 15 inches long, growing into adults that were up to 45 feet long.

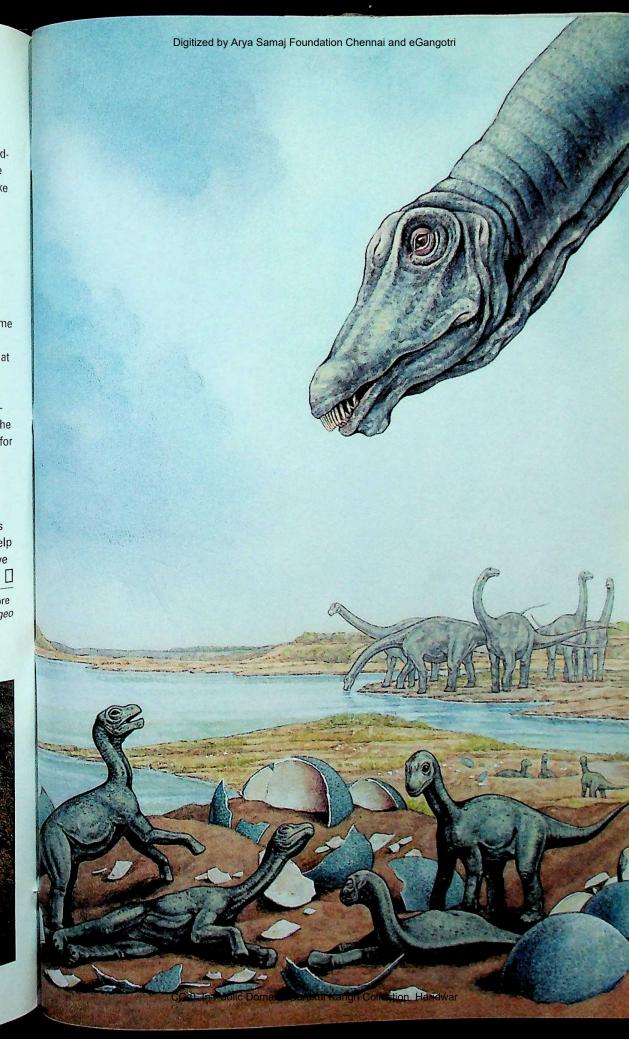
As Coria points out, "behavior rarely gets fossilized," so we don't know if the hatchlings relied on adults for care, but we do know what they probably looked like, thanks to the rare fossils found at Auca Mahuevo.

Future expeditions to this enormously rich site will help complete the picture that we have only begun to draw.

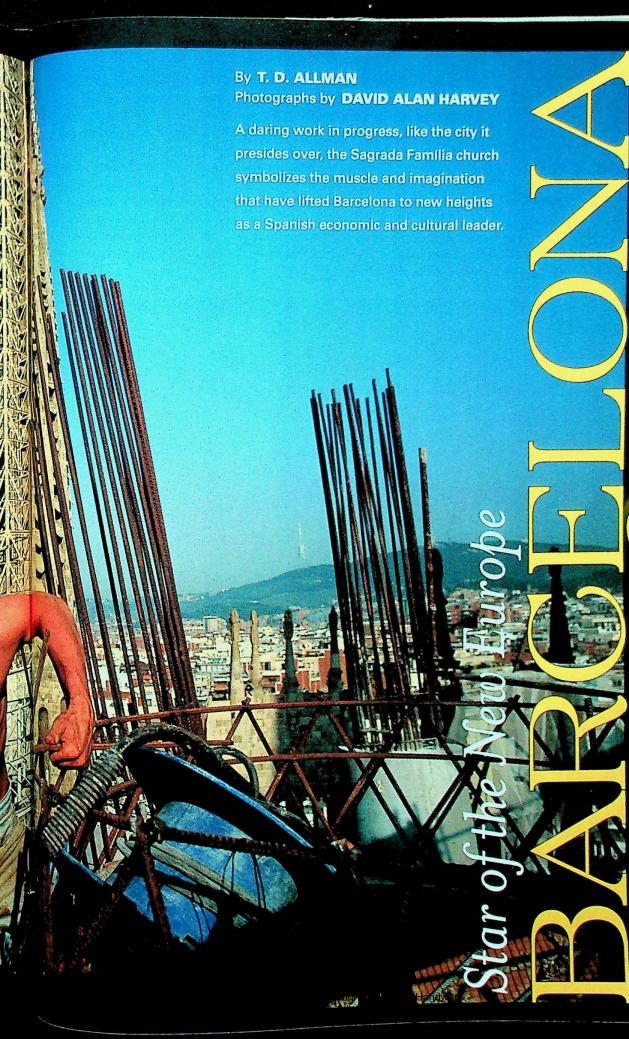
These dinosaurs and many more can be found at www.nationalgeo graphic.com/dinorama.



ection, Haridwar







N BARCELONA the Catalonians call them *castells*, but these aren't stereotypical castles in Spain. These castles are made up of human beings, not stone. The people who perform this agile feat of acrobatics are called *castellers*, and to see their towers take shape is to observe a marvel of human cooperation.

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First the castellers form what looks like a gigantic rugby scrummage. They are the foundation blocks of the castle. Behind them, other people press together, forming outward-radiating ramparts of inward-pushing muscle: flying buttresses for the castle. Then sturdy but lighter castellers scramble over the backs of those at the bottom and stand, barefoot, on their shoulders—then still others on theirs, each time adding a higher "story."



These human towers can rise higher than small apartment buildings: nine "stories," 35 feet into the air. Then, just when it seems this tower of humanity can't defy gravity any longer, a little kid emerges from the crowd and climbs straight up to the top. Arms extended, the child grins like a gargoyle while waving to the cheering crowd far below.

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Dressed in their traditional blouses, black cummerbunds, and white pantaloons, the castellers seem to epitomize an easier time, before Barcelona became a world metropolis and the Mediterranean's most dynamic city. But when you observe them up close, in their street clothes, at practice, you see there's nothing easy about what the castellers do—and that they are not merely reenacting an ancient ritual.

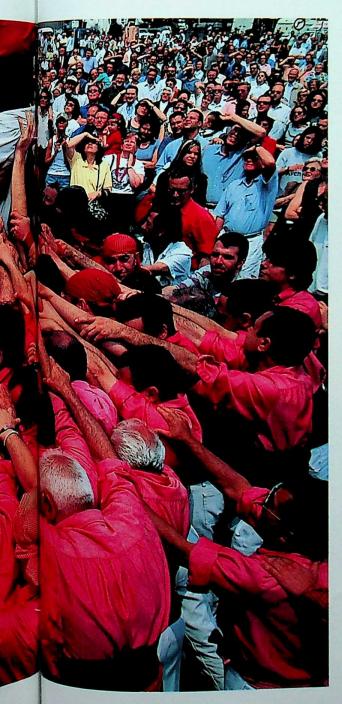
"I fell and broke my leg two weeks ago," Silvia Verdugo, a pretty and talkative 17-year-old, tells me when I visit the clubhouse of Castellers de Barcelona to observe a practice session. "I'll climb again because I love it." The clubhouse—a combination sports club, office, and tapas bar—is located in a nondescript section of Barcelona, but the castellers rebut the notion that this is something only working-class people do. Montserrat Costa, another female casteller, is a textile designer; Dani Codina is a photographer. Toni Caus, the team leader, teaches at a private school.

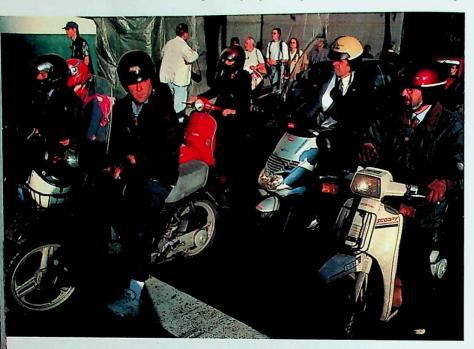
None of them can give a logical answer as to why they love doing this, but Victor Luna, 16, touches me on the shoulder and says in English: "We do it because it's beautiful. We do it because we are Catalan."

Catalan, not the Castilian Spanish standard for most of the country, and to understand Barcelona, you must understand two words of Catalan: seny and rauxa. Seny pretty much translates as common sense, or the ability to make money, arrange things, and get things done. Rauxa is reminiscent of our words "raucous" and "ruckus." "It's our redeeming touch of madness," says Xavier Corberó, a sculptor whose basalt monoliths combine solidity with absurdity.

What makes the castellers revealing of the city is that they embody rauxa and seny. The idea of a human castle is rauxa—it defies common sense—but to watch one going up is to see seny in action. Think of Madrid and Castile, or of Seville and Andalusia, and the stereotypes of flamenco and the bullfight come to mind. The castellers, in contrast, are neither showy nor macho. Success is based on everyone

Limb by limb a human castle rises as castellers engage in a Catalan sport from the 1700s. Capital of Catalonia, an independent-minded region, Barcelona revived along with Catalan culture in the 1970s at the end of the repressive regime of Francisco Franco.





Skilled negotiators of traffic—a Barcelona constant-businessmen rev their motorbikes at rush hour. Members of the café society idle in Plaça Sant Josep Oriol in the Barri Gòtic, where a passing fireeater encourages their thirst. In the early 1900s a young Pablo Picasso painted at studios in this quarter, inspired by the city's sharp Mediterranean light and shadowy street life.

working together to achieve a shared goal.

The success of Carlos Tusquets' bank, Fibanc, shows seny at work in everyday life. The bank started as a family concern and now employs hundreds. Tusquets said it exemplifies how the economy in Barcelona is different. "Profits are generated by medium-size firms, usually self-financed and family owned."

Fibanc's new headquarters on the Diagonal—the great boulevard that, just as its name implies, cuts a diagonal swath across the city—also shows Barcelona's knack for combining tradition with innovation. It is located in an old palace. "We chose to preserve the palace, while creating modern office space behind and below it," Tusquets said.

Entrepreneurial seny demonstrates why Barcelona and Catalonia—the ancient region of which Barcelona is the capital—are distinct from the rest of Spain yet essential to Spain's emergence, after centuries of repression, as a prosperous, democratic European country. Catalonia, with Barcelona its dynamo, has turned into an economic powerhouse. Making up 6 percent of Spain's territory, with a sixth of its people, it accounts for nearly a quarter of

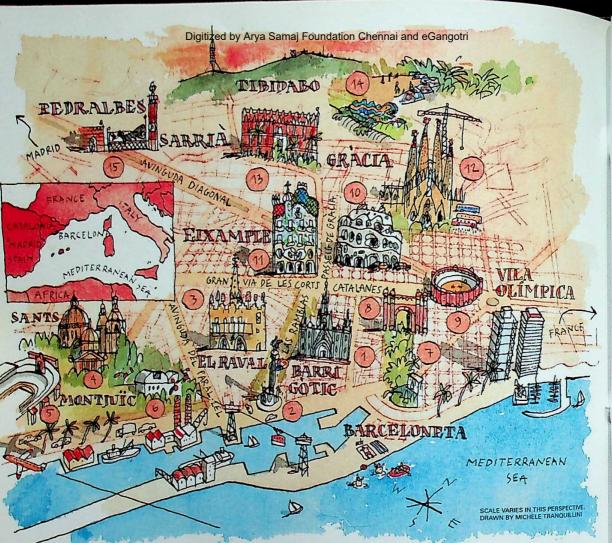
T. D. Allman's work as a reporter for such publications as *Vanity Fair* and the *Guardian* has taken him to nearly a hundred countries. This is his first article for NATIONAL GEOGRAPHIC. DAVID ALAN HARVEY'S photographs have illustrated more than 30 articles in the magazine, including "The New World of Spain," which appeared in the April 1992 issue.

Spain's production—everything from textiles to computers—even though the rest of Spain has been enjoying its own economic miracle.

Barcelona's hundreds of small family-owned restaurants, each offering its own homemade dishes of the day, also epitomize seny. They play a key economic role, for one secret of Barcelona's prosperity is that people actually have two workdays every day. The first begins in the morning, when possibilities are discussed and paperwork is gotten out of the way. Then, after lunch and into the evening, the creative work gets done, which is why people eat dinner so late

Hand in hand with seny goes rauxa, and there's no better place to see rauxa in action than on the Ramblas, the venerable, treeshaded boulevard that, in gentle stages, leads you from the center of Barcelona down to the port. There are two narrow lanes each way for cars and motorbikes, but it's the wide center walkway that makes the Ramblas a front-row seat for Barcelona's longest running theatrical event. Plastic armchairs are set out on the sidewalk. Sit in one of them, and an attendant will come and charge you a small fee. Performance artists throng the Ramblas stilt walkers, witches caked in charcoal dust, Elvis impersonators. But the real stars are the old women and frolicking children, million aires on motorbikes, and pimps and women who, upon closer inspection, prove not to be.





REY: CATEDRAL DE BARCELONA #1 MONUMENT A COLOM #3 PALAU GÜELL
#4 PALAU NACIONAL #5 ESTADI OLÍMPIC #6 FUNDACIÓ JOAN MIRÓ #7 PARC DE LA CIVTADELLA
#6 ARC DEL TRIOMF #9 PLAÇA DE TORDS #10 CASA MILA (LA PEDRERA) #11 CASA BATLLÓ
#12 LA SAGRADA FAMÍLIA #13 COL·LEGI DE LES TERESIANES #14 PARC GÜELL #15 FINCA GÜELL

Aficionados of Barcelona love to compare notes: "Last night there was a man standing on the balcony of his hotel room," Marianna Bertagnolli, an Italian photographer, told me. "The balcony was on the second floor. He was naked, and he was talking into a cell phone."

There you have it, Barcelona's essence. The main is naked (rauxa), but he is talking into a cell phone (seny).

HEN I TOOK my first evening stroll down the Ramblas, back in 1973, Spain was still in many ways a Third World country.

Generalissimo Francisco Franco's profile was on the coins, with the legend: "By the Grace of God, Caudillo of Spain." Franco was an uncrowned king, and for most of his nearly 40

years as Spain's dominant personality, cultural differences and political dissent were crushed.

One memory typifies for me how much Spain has changed. I was at the Cafè de l'Òpera, the fabled artists rendezvous on the Ramblas, and a beggar approached me. When I showed him that the points of light sparkling in my glass were the same ones glittering in the street lamps—that my glass was an optic lens—he was stunned silent. He crossed himself.

Today such people are a rare sight in the central city, where the affluent and well-educated crowd the Ramblas. Since Franco died in 1975, the number of university students in the region has more than doubled, while the number of doctors, in proportion to the population, has nearly tripled. Catalonia's infant mortality rate has been reduced by

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Grand boulevards such as Passeig de Gràcia (right) radiate from the center city. Most were laid out in the 1800s when Barcelona expanded beyond its medieval core. Spain's second largest city after Madrid and home to 1.6 million people, Barcelona cleaned up to host the 1992 Olympic Games, adding plazas, gardens, and sculpture and restoring its longneglected seafront.



more than half, and the life expectancy slightly exceeds the European Union average of 77.

Before Franco, Barcelona was one of the most creative cities on Earth. In Franco's waning days it started thriving again by doing what it still does best—filling unnoticed niches in the market. Everyone knows French champagne, but for people all over the world today the first glass of bubbly they drank was probably Freixenet, shipped out of Barcelona. A corporation owned by the Puig family has made Barcelona a major center for the perfume industry. "There are great places to work and great places to live," Enrique Puig told me. "But I don't know anywhere else where it's better to live and work."

Today Barcelona's economic horizons are not limited to Spain; they encompass Europe and the world. Since the 1992 Olympic Games, a turning point for Barcelona, tourism has become a fast-growing industry. The new airport already needs expansion, and the old freight port is now a modern cruise-ship terminal. Tourists can step off the boat and walk straight to the Ramblas.

N BARCELONA geese live in the cloister of the Gothic cathedral (the Catedral de Barcelona); art hangs in a museum in the soccer stadium; castellers have medical insurance; and on the new facade of the Sagrada Família (Holy Family) church, one of

the city's biggest tourist attractions, the centurions look like Darth Vader's stormtroopers in *Star Wars*. Every Sunday in front of the cathedral, people gather to perform the *sardana*, the Catalonian folk dance. As the dancers form circles, they pile shopping bags and attaché cases in the middle. That's Barcelona: people keeping an eye on their property while they dance.

I started collecting such incongruities one night when, from my room in the Hotel Colón overlooking the cathedral, I found myself observing brightly colored artificial creatures the size of pickup trucks surging through the streets spewing smoke and cinders at people. Why were these fire-breathing monsters rampaging on the loose? When I asked that question, everyone laughed.

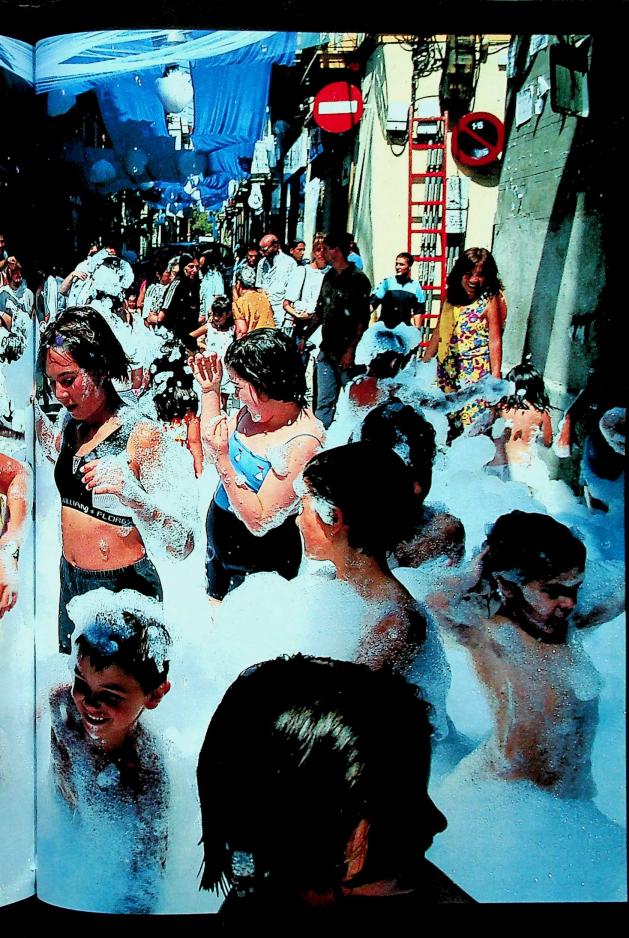
"Because of St. George," Xavier Corberó, the sculptor, explained. I already knew Sant Jordi (St. George) was Catalonia's patron saint. But I still didn't get it.

"And the dragons," he elaborated and then, pausing for effect, asked rhetorically: "Why should St. George have all the fun?"

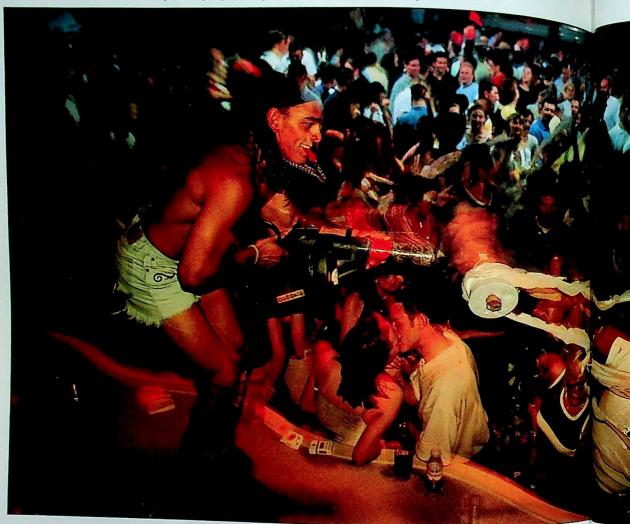
The whole of Barcelona becomes a playground during the feast of Sant Jordi every April and then again in September as the city, with typical incongruity, celebrates one of the greatest military defeats in its history when Bourbon armies crushed Catalan liberty in 1714—as Catalan National Day. During such festivals every corner of the city pulses.



Bathed in bubbles, children play at a party in the Sants neighborhood. Barcelona entertains itself with



If with some 140 yearly festivals, celebrating everything from saints' days to a historic defeat in battle.



Then, at the very moment the nightly festivities end, street cleaners swing into action. Seny takes over from rauxa, in the form of an army of smartly uniformed, efficient municipal employees and their garbage trucks and water hoses. Right now it's 7 a.m., a few hours after dragons rampaged through the streets. The square is empty. Barcelona is sleeping; it won't really begin to hum again much before noon, but the square is spotless.

A successful city, like a successful actor, must constantly invent new roles for itself. A good way to get an idea of the different roles Barcelona has played is to ride the Ferris wheel in the Tibidabo amusement park. The shape of the streets beneath you shows how Barcelona has been reinventing itself for a thousand years. The original streets of the old city twist around each other like strands of DNA.

It took Barcelona 850 years to form this pulsing nucleus of commercial, ecclesiastical,

and administrative power where Spain, Europe, and the sea come together. Then, nearly 150 years ago, mutation occurred. The city burst out of its medieval walls. It surged outward, upward, covering mile after mile with rectilinear urban planning. Yet slicing across this neat rectilinearity is the Diagonal, connecting the Iberian hinterland, via Barcelona and its port, to the seacoast roads to France and the rest of Europe.

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Spain, Europe, the sea: The nexus of all three is what makes Barcelona Barcelona. A century and a half ago, thanks to the arrival of the industrial revolution, that nexus generated unprecedented wealth. Until then, all the gold of the Americas and all the captains of Castile had not made Spain rich. But then Barcelona pioneered a degree of popular affluence previously unknown on the Iberian Peninsula. Resourceful citizens of Barcelona built Spain's first railroad and set up textile mills. They created wealth instead of consuming it.

52



It's 5 a.m. at the Baja Beach Club, and patrons can barely hear themselves kiss as a barkeep handy with a blower sprays toilet paper into an allaccepting crowd. "We don't quit until breakfast," boasts a regular. Dozens of clubs cater to the hedonistic night shift. While revelers sleep it off, workers at nearby car and chemical plants keep the region's industrial reputation intact.

it got rich? It created a whole slew of crazy objects that, like the castellers and their castells, turned out to be surreal, even scary. The work of Barcelona's most famous architect, Antoni Gaudí, epitomizes this fusion of virtuosity and delirium. Gaudí designed apartment houses that look like emerald-studded albino iguanas. He built oozing colonnades that might have been molded from dinosaur dung. In a certain light Gaudí's Casa Batlló looks less like an apartment house than a concrete-encrusted, multimouthed invertebrate that just might suck you in and eat you.

Gaudí is also the one who designed the inescapable towers of the Sagrada Família that seem to appear on every Barcelona postcard. When George Orwell first saw them in the 1930s, Gaudí's towers reminded him of bottles of German hock. That was no compliment,

since Germany then was Nazi Germany, and Orwell had come to Barcelona from England to fight fascism, the experience that ultimately produced *Homage to Catalonia*, his account of futility and suffering during the three-year Spanish Civil War.

While Barcelona's architects were changing what we see, the city was nurturing three painters—Joan Miró, Salvador Dalí, and Pablo Picasso—who changed our view of the world.

In his painting "The Farm," Miró distilled the seny of Catalan peasant life, then infused it with the rauxa of specific objects. Agricultural implements and livestock populate his canvases with the same quirky individuality that oddballs and outcasts bring to the Ramblas. Yet here's the incongruity: When he painted "The Farm," peasants were abandoning their farms for Barcelona's factories.

Salvador Dalí, with his waxed mustache and madcap glare, is like the Sagrada Família. Loathe him or love him, there's no escaping him. For decades he marketed his product (initially his art, later his belabored eccentricity) as insistently as Barcelona marketed itself for the 1992 Olympics.

Though born in Málaga, Pablo Picasso wound up in Barcelona because his father, like migrants today, was drawn to the city in the hope of finding work. Barcelona's influence is written all over Picasso's two most famous paintings. The title of "Les Demoiselles d'Avignon" refers to the Carrer Avinyó, or Avignon Street, where Picasso used to observe the girls in the whorehouses. "Guernica," Picasso's passionate evocation of the firebombing of that town, depicts the independence of spirit and love of freedom he absorbed while hanging out around the turn of the century at the Four Cats, rendezvous of Barcelona's most influential artists and thinkers.

arcelona's greatest incongruity is that this marvelously civilized city is a place where, within living memory, civilization broke down.

"Of course we ate rats," Nicolau Casaus, vice president of Futbol Club Barcelona, told me. Casaus, now 85, is one of that diminishing number of people who can describe what Barcelona was like during the Spanish Civil War. The war, a military revolt against Spain's democratically elected civilian government,



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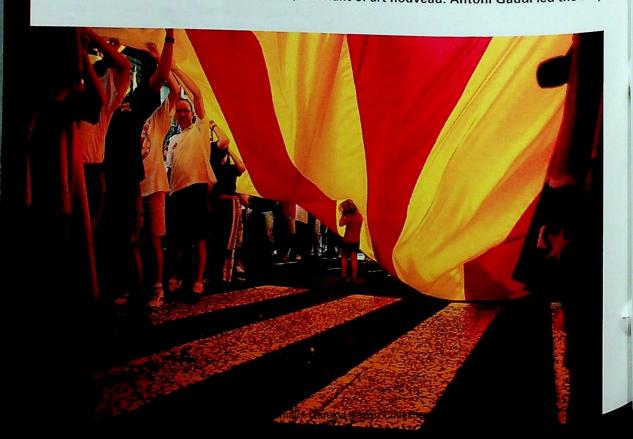
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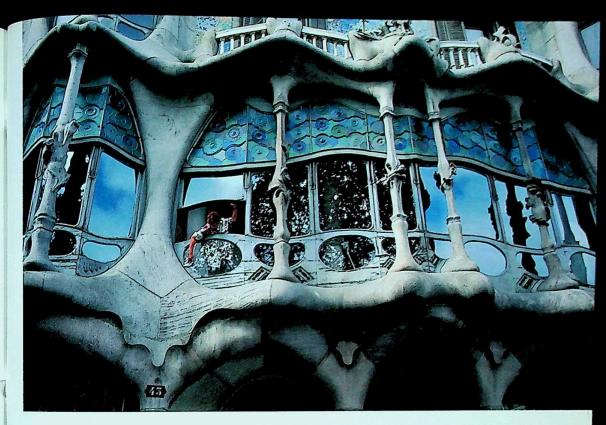
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Suntans and sun hats enliven the revived downtown waterfront (above), a former warehouse district the city redecorated with palms and sand. Perhaps the most design-conscious European city, Barcelona first won aesthetic notice in the late 19th century with its lush modernista architecture, a variant of art nouveau. Antoni Gaudí led the way





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with dreamlike creations like Casa Batlló (above). Playful, innovative designs rule at a local fashion academy (below), where a student models a bold outfit. Beyond love of fashion is the city's devotion to Catalan autonomy. Eager to wrest more power from archrival Madrid, citizens parade the once outlawed Catalan flag (below left).





Designer skyline with glowing pillars and a sculpturesque telephone tower, seen from the Olympic

[⊕]Splana



 $^{\$\$planade}$, reminds strollers of the city's adventurous, multibillion-dollar makeover for the '92 games.

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began in July 1936 with an uprising in Spanish Morocco and ended on April Fools' Day, 1939, with victory for Franco's Falangists, the military rebels. Following his victory, Franco crushed Catalan autonomy and banned official use of the Catalan language.

"The Catalan spirit couldn't be crushed," said Casaus. "Repressing it forced it into different forms of expression-including football."

To see the Catalan spirit, I went to a neighborhood near the Gràcia section of the city. At a garage door I pressed the buzzer, and eventually the door opened. I was ushered up a narrow staircase into the presence of Antoni Tàpies, Catalonia's most eminent living artist.

An unhistrionic man, whose art nonetheless has excited flamboyant controversies, Tapies is to contemporary Catalan painting what Futbol Club Barcelona is to sport: a focus of Catalan pride, a national institution for a people long denied the traditional political and military expressions of nationalism. One of his most famous works is "The Catalonian Spirit."

For someone who's never lived under a dictatorship, it's hard at first to see why it aroused such a furor. It's just a canvas on which Tapies painted a Catalan flag, then scribbled over it the names of famous Catalonians. Yet until Franco's death police prevented art galleries in Barcelona from exhibiting such work.

In Orwell's time Barcelona was a model of Europe—a model of all the horrors to come. Spain was to Europe then what the former Yugoslavia is to the continent today, and Barcelona—as a focus of European barbarity—was its Sarajevo.

"Yes, once we were the Sarajevo of Europe," Pedro Durán, a prominent Barcelona entrepreneur, said as we discussed his many financial and aesthetic ventures. At 77, Durán, like Nicolau Casaus, remembers Barcelona during the Civil War.

"And what are we now?" he asked.

He thought for a second, then said: "We're the Barcelona of Europe."

One of Durán's multibillion-dollar projects connects gas fields in Algeria with Spain through underwater pipelines traversing the Strait of Gibraltar. "We planned it all here in Barcelona," he told me. He added: "You can always borrow money and buy technology; it's people who count."

Durán, too, had his theory as to why the

Above the cares and temptations of the worldly city at her feet, eight-year-old Elisabeth Haro Gómez caps her first Communion day with a visit to an amusement park on the Montjuïc heights. Barcelona itself sits on a lofty threshold, poised to assume a new identity as a great European capital and first city of the Mediterranean.



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Catalan spirit survived. "Madrid was built by the state, but Barcelona was built by its people. Barcelona has always been built by its people's own work, without the intermediary of the state." For hundreds of years Barcelona was the victim of history because Catalonia was not a nation-state; it lacked an army, its own king, and national borders. Now the city seems on the right side of history for the same reason. Barcelona is pioneering a new kind of European identity in which global sophistication and economic reach combine with newly restored regional power and pride.

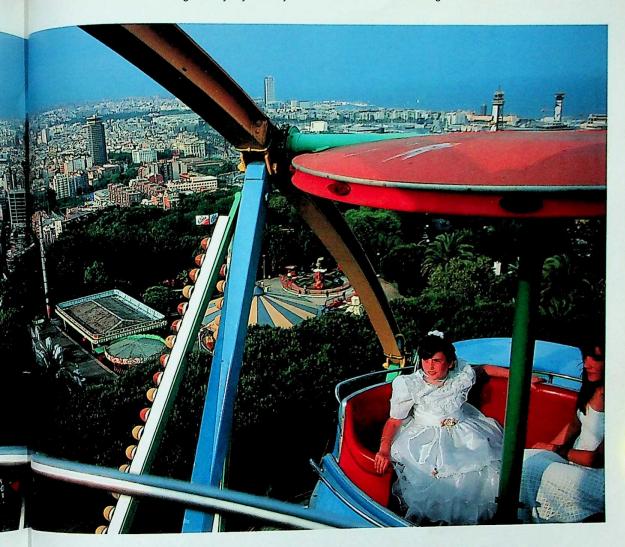
"We've learned the most important lesson." Durán said. "Never violence. Never again."

"You've got to see the Plaça Sant Felip Neri!" Albert Montagut, editor of the Catalonia edition of Flat tion of El Mundo, one of Spain's popular news papers, said one day as, befitting professional colleagues, we enjoyed a three-hour lunch.

I'd just mentioned the lesson of history

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58



Durán recounted. Suddenly Montagut was on his feet, grabbing the bill. Before I knew it, we were dashing through the backstreets of the Gothic Quarter, or the Barri Gòtic. I followed him into an alley—suddenly all the bustle of Barcelona was gone.

The plaza was actually a mottled stone circle, formed by the curved facades of old buildings. One of them was a church. We were not entirely alone under the blue circle of sky. Two men in their mid-20s were standing in front of the church. They were looking at something.

"The last bullet holes in Barcelona," Montagut told me. "Once they were all over the place, but gradually they've disappeared."

Though Spanish, the two young men, who came from outside Catalonia, were dressed like tourists, in bright T-shirts. "It's hard to believe things like this once happened in our country," one of them said. Then the other said the

same thing Pedro Durán had: "Never again."

I asked them to write down their names: Miguel Pollon Quintero, Luis Siquea Fuentes. I also asked what they did for a living. "We make and sell T-shirts," one of them answered.

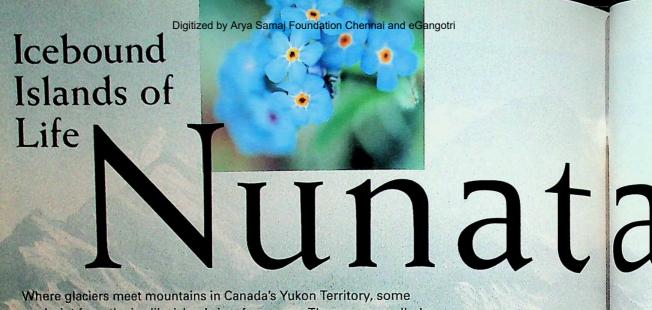
Merchandising T-shirts doesn't compare with the "heroism" Europeans have shown for centuries as they bounded across Europe and the world, killing and being killed. But those two T-shirt guys are deserving of homage. As they prove, the essential thing is people, and people's understanding of themselves. Sarajevo, too, had its Olympic Games. But something was missing in the soon-to-become ex-Yugoslavia: an essential understanding.

"The dragons are inside ourselves," Jordi Pujol, Catalonia's president, likes to say when the subject of St. George comes up. Once you realize where the dragons are, anything—even a new Europe, no longer soaked in blood—is possible, as Barcelona shows.

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Where glaciers meet mountains in Canada's Yukon Territory, some peaks jut from the ice like islands in a frozen sea. These crags, called nunataks, may appear barren, but biologist David Hik, the skier at far right, has discovered that collectively they harbor hundreds of species, from delicate alpine forget-me-nots (inset) to foraging mammals.

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By KEVIN KRAJICK Photographs by ROBERT CLARK

N THE GLACIERS of the Yukon Territory's St. Elias Mountains, winter temperatures hit 40 below, driven by hurricane-force winds. Even a full summer sun can turn in an instant to freezing fog and sleet. "In its eternal solitude, its awful silence, its absence of any forms of life, vegeta-

tion, or running water, one sees a picture of the utter desolation which once existed during the great glacial periods," wrote H. F. Lambart, one of the first recorded explorers of the region.

Lambart was wrong. This seeming wasteland does hold life-on small, sharp tips of mountains that poke through the sea of ice. They are called nunataks, an Inuit word meaning "land attached." Archipelagoes of them, most no bigger than a few acres, are scattered across Earth's polar regions and tallest ranges.

Since the 1800s scientists have speculated that many of today's mountains were nunataks during the ice ages, serving as arks from which "CLIMBING these rocks is no walk at the beach," says Hik (above). After scrambling up an unstable slope, he finds his quarry: a tiny meadow on a ledge. Plants drive nunatak ecosystems. The sedges Hik collects feed guinea-pig-size animals called pikas. Moss campion's dense network of shoots allows less hardy plants to gain a foothold (above left).

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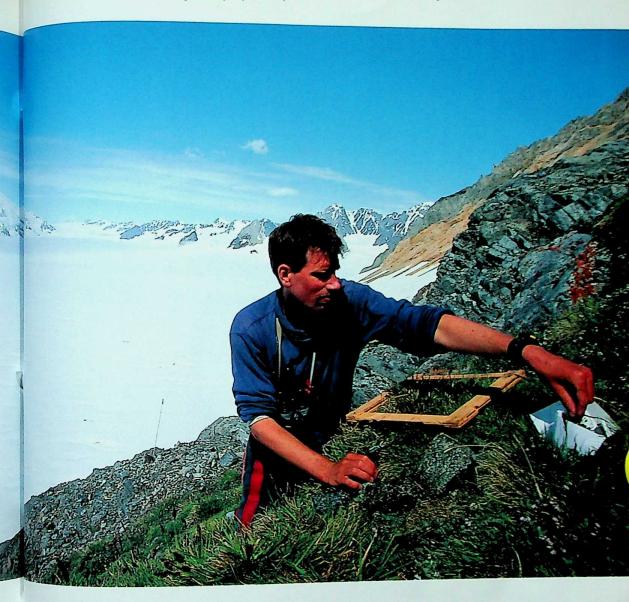
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KEVIN KRAJICK often writes about the natural world for magazines such as Natural History, Smithsonian, and Discover. This is his first story for NATIONAL GEO-GRAPHIC. ROBERT CLARK'S photographs of the excavation of French explorer La Salle's ship Belle appeared in our May 1997 issue.

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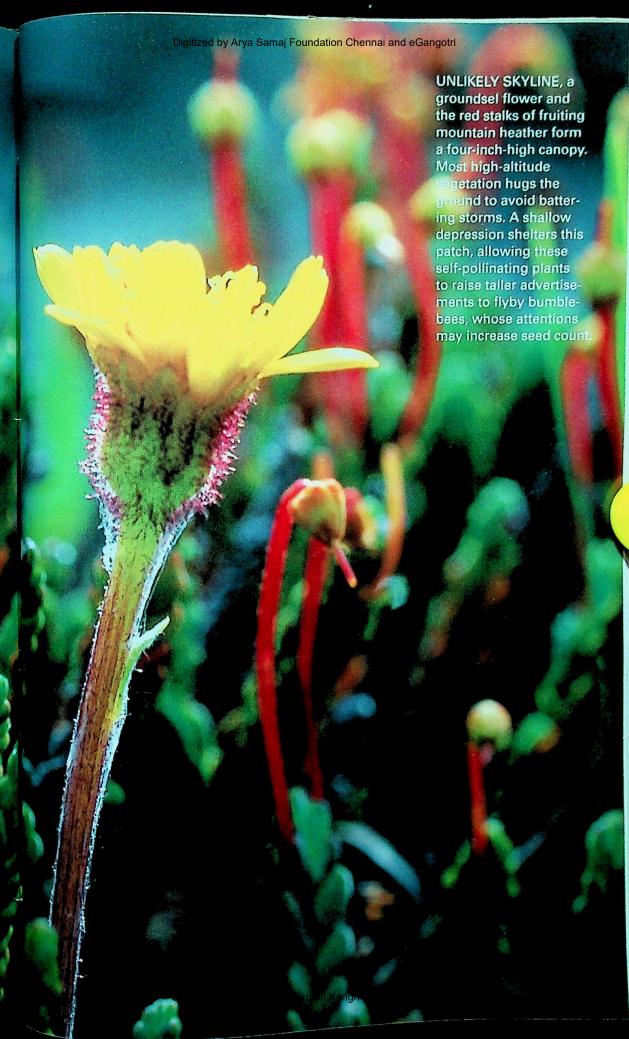
plants and animals spread when the climate warmed. But little was known about nunatak ecology until David Hik, a biologist from the University of Toronto, began a long-term study in Canada's Kluane National Park Reserve. There, in the midst of 16,000 square miles of ice fields that stretch into Alaska, Hik has discovered flower meadows no bigger than blankets hosting spiders and rare insects; eerie graveyards of migrating birds that lost their way; and collared pikas, small mammals that somehow navigated across crevasses, melt streams, and the sheer unsheltered vastness of the ice to dwell amid nunatak boulders.

Since 1991 Hik and his colleagues have cataloged 158 species of lichens, mosses, and plants, as well as a lifetime's worth of weird wildlife observations. All the species appear to

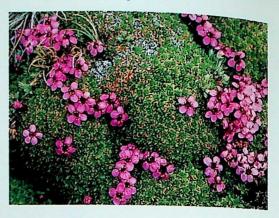
have come from the outside world—insects and seeds, for example, are blown by the wind. Along with Eliot McIntire, an ecology student, and Merav Ben-David, a wildlife biologist from the University of Alaska, Fairbanks, I joined Hik not long ago to discover how life hangs on in such pitiless conditions.

Hik loves his job. "Glorious summer, good as it gets!" he cried gleefully, sweeping his arm in a circle to show off the Seward Glacier, a 400-square-mile rolling plain of ice believed to average a half mile deep. "Welcome to my office!" We were headed toward an island of shattered rock rising 300 feet out of the ice. Around it, swirling winds had scooped a moat that plunged through the ice and bottomed out in a maze of gurgling melt streams. A high tongue of the Seward lapped up its far side,









THE DIVERSITY OF SPECIES on nunataks takes patience to grasp. Only the showiest, such as moss campion and orange lichens, grab the eye. Wait and you might glimpse an alert wolf spider or resting butterfly. How did life reach these isolated peaks? Winds bore most pioneers over the glaciers. Plants were carried as seeds. Young spiders sailed in on strands of silk.

providing a ramp onto a steep heap of razoredged boulders. As we gingerly ascended, every rock seemed on the verge of tipping over. We just had to move slowly and carefully.

At the summit we saw the first signs of life. A gray Bohemian waxwing with delicate white-and-yellow feather tips had wedged itself into a cold crevice and died. These lovely songbirds like to winter as far south as Texas. This one must have taken a wrong turn. A single life-form from the outside world sometimes has a powerful effect on the scant nunatak ecosystem. Directly below the waxwing a small moss bed had sprouted—its spores perhaps blown in from outside or brought by the bird that was now nourishing the moss with its decaying body. We turned the waxwing over, and its body squirmed with larvae.

In succeeding days we found dozens more pitiful corpses curled into cracks or laid out on high rocky pallets—sparrows, thrushes, warblers, and the skeleton of a solitary sand-piper. A Kluane park warden once came across a nunatak snowbank whose side had peeled off to reveal a layered cross section of many years' accumulation of ice and snow. Interspersed among the layers, like raisins in a cake, were generations of dead birds. A helicopter pilot

reported seeing a whole flock of swans crash into a nunatak cliff during a snowstorm.

How do so many birds end up here? More than a hundred species migrate to low-lying Arctic or subarctic breeding grounds north and east of the ice fields. Some decide to take a shortcut over the mountains; others get lost. Above the glaciers birds are probably forced down by wind, iced-up wings, or exhaustion. "I think the nunataks must look like oases to them in all this snow," said Ben-David. "They land here, but there's not enough for them to eat, no way to get warm. That's the end."

On almost all the nunataks, we found signs of an end use for the birds: finger-size pellets of scapulas, beaks, claws, and other indigestibles regurgitated by ravens that live on the ice field edges and scavenge the corpses.

In the deep, dark interstices between boulders we found something equally macabre: little piles of birds neatly stacked like cordwood, as if something was collecting them. Something is. Collared pikas, which use the space between rocks as tunnel complexes, had brought the corpses back to feed on. In the world beyond the nunataks, pikas are vegetarians. Here plants are so scarce it appears that the pikas supplement their diet with meat. They are the only mammals able to live off such a meager food supply. Weasels and wolverines venture by, but they quickly flee or die.

The pikas sometimes chew a hole through the delicate bird skulls to get at the brain, leaving the rest. "By the time the birds die, there's not much a pika could digest. They're down to feathers, bones, and a few tendons," said Hik. But brains are like pâté—pure, digestible protein and fat. "If I were going to slice and dice a bird, that's the part I'd choose. Even if they get

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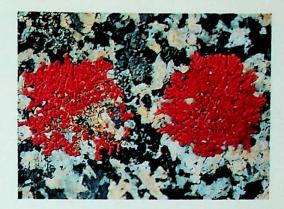
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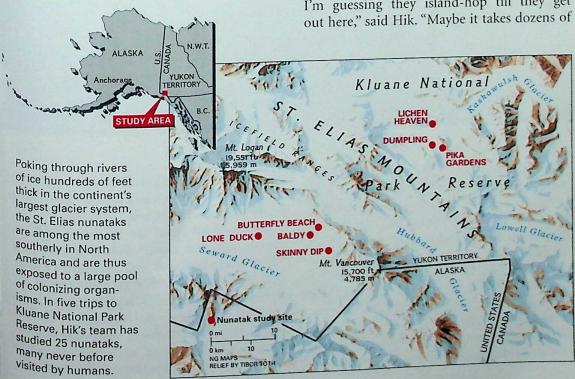
just a few a year, it may make the difference between surviving or not."

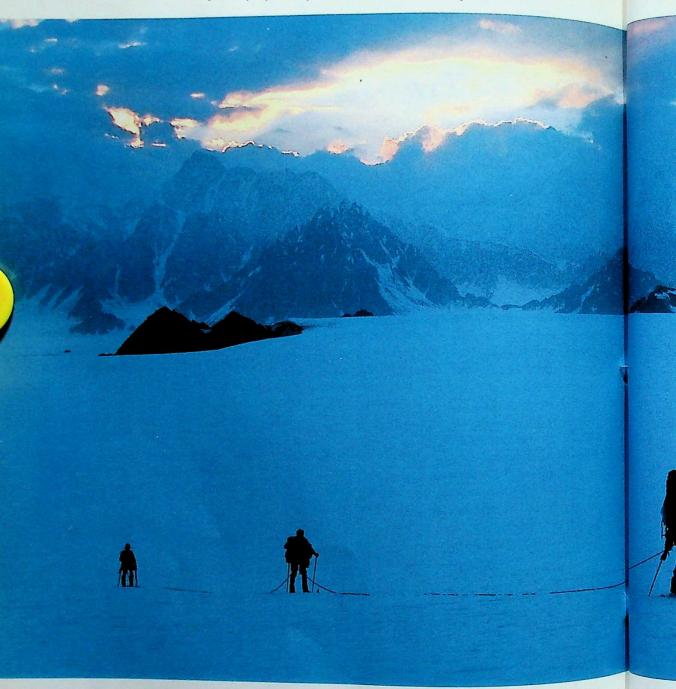
Pikas also harvest plants during summer and pile them up in their dens like haystacks to help survive winter. In the same crevices with the mangled birds we found a few withered handfuls of grass and flower heads. They smelled like the dried grass my father-in-law lays up in the loft of his sheep barn every fall. But there were no pikas.

Hik figured bad weather or the rare predator had killed them. But later when he was off collecting plants, I glanced up to see something that looked like a furry hot dog regarding me from a rock. It snuffled its whiskered nose, gave a bathtub-toy squeak, and disappeared down

a hole. "You sure it was a pika?" asked Hik, who sprinted back when I hollered. Soon the six-foot-three, basso-voiced biologist was crawling around the rocks doing a poor pika imitation in a bid to draw the critter out. It answered but refused to show itself.

I wondered how this creature, or its ancestors, arrived here. "I haven't a clue," Hik admitted. With legs as short as a joint or two of your little finger, pikas are not good travelers. Normally their territories are measured in yards. They rarely emerge from their dens for more than a few minutes because direct sunlight easily overheats them. Yet at least one pika was on this nunatak, 75 miles from the nearest "mainland" pika colony. "Since some of these nunataks are only a few miles from each other, I'm guessing they island-hop till they get out here," said Hik. "Maybe it takes dozens of





generations to get a population out this far. But of course I'm just guessing."

How pikas find mates is another mystery. Most nunataks seem to have only two or three pikas. Do brothers, sisters, and parents perpetuate a slim family tree, or do they disperse to other nunataks? No one knows.

"Poor little things," said Ben-David. "They are just little bags of skin and bones." We were lying on the glacier one morning, pressing our faces to the snow to get a pika's-eye view of the world. At this angle a nunatak a mile distant

disappeared behind the rolling ice—pikas can't depend on vision for navigation. "Maybe they smell flowers," Hik mused.

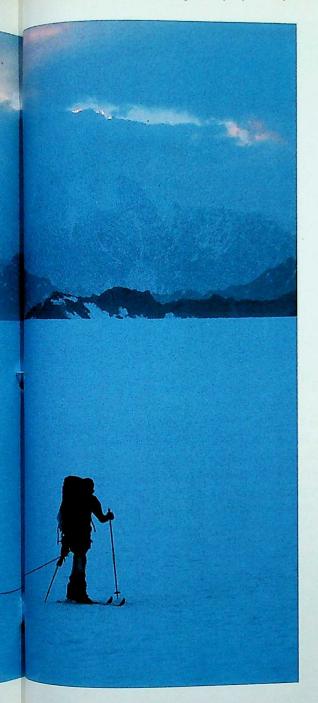
He could be right. On the sere ridges we sometimes came across a few square yards where pulverized rock had managed to settle in a relatively level spot with a southern exposure. Here, seeds of typical alpine plants from surrounding unglaciated mountains created minuscule, sweet-smelling flower gardens: nitrogen-fixing oxytropis with delicate purple petals, tiny poppies, daisies, Jacob's ladder,

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NATIONAL GEOGRAPHIC, DECEMBER 1998

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dandelions, potentillas, and saxifrages, all blooming together in a summer day's 22 hours of sunlight. Many plants have hairy leaves to hold heat, and some have flexible horizontal stems, a dozen feet long or more, that hug the terrain and can slide along with moving rocks. One ledge protected by an overhang held a mattress of sedges and grasses watered by a terraced waterfall, and in its trickle a huddle of tiny brown mushrooms. McIntire, our botanist, spent his days scrambling on his knees with a magnifying glass and plant

CHILLED by creeping darkness, the team slogs home from nunataks called Baldy, far left, and Butterfly Beach, the dark ridge at right. A rope binds them for safety. "We can see big holes," says Hik. "We can't steer clear of snow-covered cracks." A thousand yards ahead lie camp, dry clothes, and the end of a 16-hour workday.

handbook trying to keep up with the variety.

Hik and his colleagues have christened these lonely hills with names like Lichen Heaven, Baldy, Pika Gardens, Lone Duck, Butterfly Beach, and Skinny Dip-the last for a brief swim we dared in a turquoise moat pool. One called Dumpling, on the 35-mile-long Kaskawulsh Glacier, jutted 300 feet up. Its southern slope was dotted with rich miniature meadows, where we saw insects-dragonflies, bumblebees, moths, butterflies, and black-and-white striped flowerflies-milking nectar or otherwise making a living. Waiting in the rocks for them were black wolf spiders, which dwell in silken lairs with eyelike openings. Their long legs carry them in pursuit of prey high across stony ground. These predators may sail many miles from lowlands on special threads and subsist on insects rained down by the wind.

Many of these insects are typical alpine and arctic varieties. But some are unexpected finds. A few years ago Hik collected a half dozen butterflies. One was a hairy, purplish black creature with a greasy sheen. Don Lafontaine, an entomologist with the Canadian government, recently identified it as the extremely rare *Boloria natazhati*, known from only six other areas in northwestern Canada—most of them former nunataks that became freestanding mountains after the last ice age. Two others turned out to be an equally rare patterned moth, *Xestia maculata*. "That's three out of six," Lafontaine said. "If you went and did a thorough survey, there's no telling what you'd find."

The more we looked, the more life was revealed to us. As soon as we reached Dumpling, two pikas greeted us with squeaks. Within minutes, Hik was doing his pika imitation again—this time with greater success. Soon the pikas scrambled onto rocks and looked us up and down. When Ben-David turned her back, one scampered out and lapped at a novel nutrient source: the sweat on her backpack straps. These pikas, isolated from predators,

seemed easily fooled. Ben-David baited some wire traps with flowers and soon caught one. She cradled it in her hand, clipped a few hairs from its back for later tests, and set it free. The hairs contain stable isotopes of carbon and nitrogen that signal what proportion of plants and animals the pikas eat—the main question Ben-David has been studying.

That same day a pair of snow buntings whirled into the Dumpling meadow in tandem and began picking insects off plants. These black-and-white, robin-size birds are among the few that breed here. They sang merrily as they worked their private kingdom, then headed over a ridge behind a sheer cliff-a typical nesting spot. The previous year Ben-David and Hik had seen a pair of snow buntings here—perhaps the same two—and then a few days later two newly fledged buntings bumbling over the meadow. We also saw a horned lark, another nunatak nester, snatching flowerflies blown off the rocks onto the ice, where they were too chilled to move. One evening I heard a whirring above my head and looked up to see a rufous hummingbird. It hovered high over the meadow, then disappeared over a ridge on some unknown journey.

How long has such life been here? It depends partly on the age of the nunataks. Gerry Holdsworth, a University of Calgary glaciologist, thinks most St. Elias nunataks probably emerged from the ice about 12,000 years ago, shortly before the end of the last ice age. No one has yet found endemic species on nunataks, which supports the idea that their history has been too short for evolution to take place, though there may also be too much contact with the outside gene pool. Comparing the DNA of nunatak pikas with that of mainland pikas will reveal whether they have been isolated long enough to diverge genetically.

E LIKED TO IMAGINE we were the first to climb these nunataks. Indeed, we never saw another person. Native groups like the Southern Tutchone, who live in wooded valleys to the east, have largely avoided the ice fields, which in their legends harbor giant snakes and owls.

But we know humans have visited at least one. On Hik's first trip he stumbled across a reddish brown hunk of fur at the base of a Kaskawulsh nunatak. It was clinging to a stone just melted out of the glacier. Archaeologists later identified it as a thousand-year-old fragment of bearskin. On its edge someone had cut slits and attached a leather thong, perhaps to use as clothing or as a container. "I was absolutely floored," said David Arthurs, a Parks Canada archaeologist who has examined the skin. "It's the only human artifact ever recovered from the St. Elias ice fields."

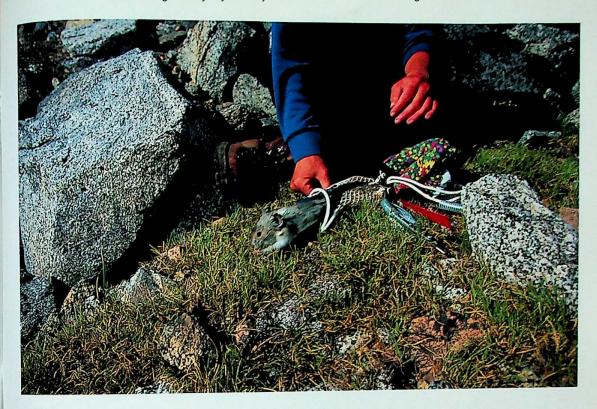
The bearskin's owner would have traveled through a maze of cliffs, icefalls, moulins, and melt streams. The legends of several native peoples, including the coastal Tlingit, speak of trade routes across smaller glaciers farther south. Or maybe the nunatak had spiritual significance. We will probably never know.

On our last day Hik, McIntire, and I skied into the dawn to revisit the discovery site, several miles away. The place had a deathly grandeur—a towering central column surrounded by billions of rock shards, underlain by a sloping layer of ice that made climbing out of the question. No bird sang, no lichen grew. The only whispers of life were a few fossil clams scattered among the rocks.

The Southern Tutchone have stories about two men who dared enter the ice fields. One fell into a hole and landed on a dry island; the other fled home to get help. The man in the hole survived more than ten days by wearing a succession of pelts—beaver, moose, gopher. Finally his friends struggled back, weeping, to retrieve his body. Finding him alive, they fed him, warmed him, and carried him until he could walk. The man told his rescuers he had had a vision of them mourning him at a potlatch—which indeed they had.

I thought of this story and of the traveler with the bearskin. What had he endured on this barren island on the ice? We were leaning, dead tired, on the rocks when an icy wind suddenly roared down the Kaskawulsh. It brought a solid wall of crystalline fog that blotted out the sun and everything more than a few feet away. Soon it would turn to whipping snow and sleet. We had little food and the temperature was dropping. But unlike the ancient traveler, we had tools to guide us. Hik calmly pulled out his compass and took a reading. As we skied into the whiteness, I glanced back at the island one last time. It had already disappeared in the mist.

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QUEEN OF HER HILL, a newly tagged pika bolts to freedom. Pikas are the only year-round mammal residents here. Many birds are doomed strays, grounded by storms during migration. Chemical traces in pika hairs and the hole on the other side of this dead sparrow's head suggest that pikas supplement their diet with high-protein brains. On nunataks the tough survive, but only the adaptable prosper.





Ith all cares astern, a young crew skips over choppy seas in "Breezing Up," one of Winslow Homer's most beloved oil paintings. Completed during the centennial year of the United States in 1876, the work reflects the nation's mood—a burst of exuberance following the turmoil of the Civil War.

Respected as a chronicler of war and admired as an observer of postwar life, this largely self-taught painter set an independent course for his career, which lasted 50 years and ranged over many moods, from tranquil to stormy. "To look at him, one could not imagine him painting," said a friend, who thought the dapper Homer seemed more like a successful stockbroker (overleaf).

Homer was a hundle of contradictions. A blunt, practical loner, he rebuffed inquiries about his personal life. But his small circle of friends and family knew him as generous and kind, with a dry Yankee wit and keen interest in people that still shine through his finest work.



By ROBERT M. POOLE

Photographs by SAM ABELL

Two strangers meet walking the ragged cliffs of Prouts Neck, Maine, where the Atlantic pounds the resisting granite so hard that conversation is often shouted.

"I say, my man," says one of the two, obviously fresh from the city, "if you can tell me where I can find Winslow Homer, I have a quarter here for you."

The other man, a Yankee fisherman with a drooping mustache, wears an old

felt hat and rubber boots. He is small and weather-beaten, with the skeptical look of a terrier, and just as quick to pounce: "Where's your quarter?"

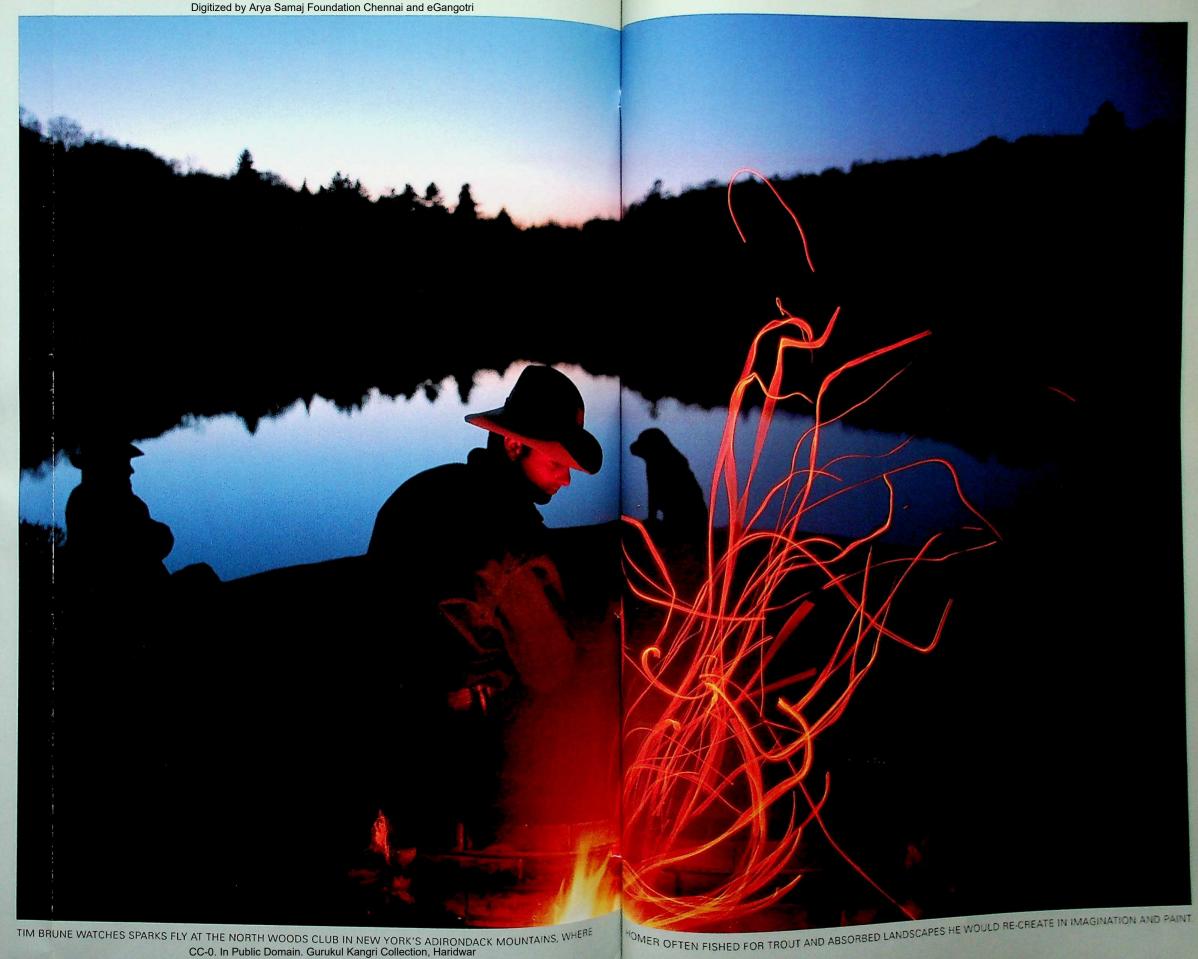
The stranger hands it over.

"I am Winslow Homer," says the fisherman, taking the money.

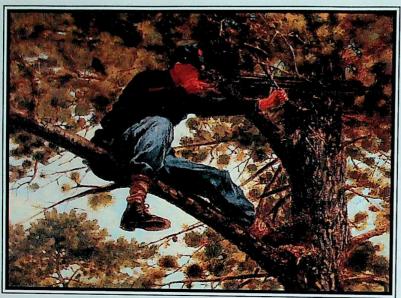
He is also the most famous American artist of his day, which spanned the 19th and 20th centuries. Although largely selftaught, Homer became a master of etchings, oils, and watercolors. On his own he developed Impressionist techniques like those Monet and Renoir perfected years later. He changed the way Americans saw watercolor, elevating an amateur form to a serious art. He influenced generations of artists, ranging from Rockwell Kent to Edward Hopper to N. C. Wyeth, who named a house

Eight Bells after a Homer painting. Homer's vision, like the man behind it, was unique to the point of stubborn-

ness. Others painted indoors. Homer painted in daylight long before it became standard practice. Others painted blue skies. "It looks like the devil," said Homer, who avoided them, filling his skies with gray, yellow, pink, white—anything but solid blue. Others depicted the horizon with a straight line. "Horrible," said



TIM BRUNE WATCHES SPARKS FLY AT THE NORTH WOODS CLUB IN NEW YORK'S ADIRONDACK MOUNTAINS, WHERE CC-0. In Public Domain. Gurukul Kangri Collection, Haridwal



PORTLAND MUSEUM OF ART, PORTLAND, MAINE

"ve seen them pick a man off who was a mile away," said a Confederate officer harassed by Union marksmen as in Homer's first oil painting, "Sharpshooter." Years after the war Homer continued to draw on the mortal themes he had learned, as in his stark rendering of the man scything grain in the painting "Veteran in a New Field." The reaper, just home from killing fellow countrymen, recalls a lesson from Psalms: "As for man, his days are as grass."

Homer. He broke his horizons with dots of light, giant waves, plunging boats, and mountains. Others treated subjects romantically, bathing their canvases in golden light. Too easy for Homer, a pioneer in realism. He got at the underlying truth of a subject, even if it meant hours of waiting for the right light or torturing his neighbors at Prouts Neck.

To catch the look of rough seas, he posed one of them, Henry Lee, in oilskins for hours on a cold day, in a boat propped on shore at a steep angle. Homer doused him with a bucket of water, apparently without warning, to complete the effect. "You never heard such profanity in your life," according to a witness who was there for the genesis of "The Fog Warning."

Such attention to reality was at odds with artistic convention in Homer's time, as was his choice of subjects—barefoot boys, farm girls, working men, freed slaves, North Woods guides, ordinary soldiers, and women of leisure, all of whom represented everyday life in America. Early critics complained about it, grumping that Homer's pie-fed maidens were unfinished and rough, like his painting style. But like other American originals of his time— Walt Whitman and Mark Twain—Homer kept to his own path. Although he was overshadowed by more modern artists in this century, the Old Yankee's timeless themes and enduring style won out. In 1998 one of his marine oils, "Lost on the Grand Banks," sold for more than 30 million dollars, breaking all records for an American painting. The buyer was Bill



Gates, whose name Digitized by Arya Samaj Foundation Chennai and eGangotri is synonymous with curator of American a ephemeral communication. Yet when he sought something of permanent value, Gates turned to old-fashioned oil on canvas. Homer might have had a good chuckle at that one.

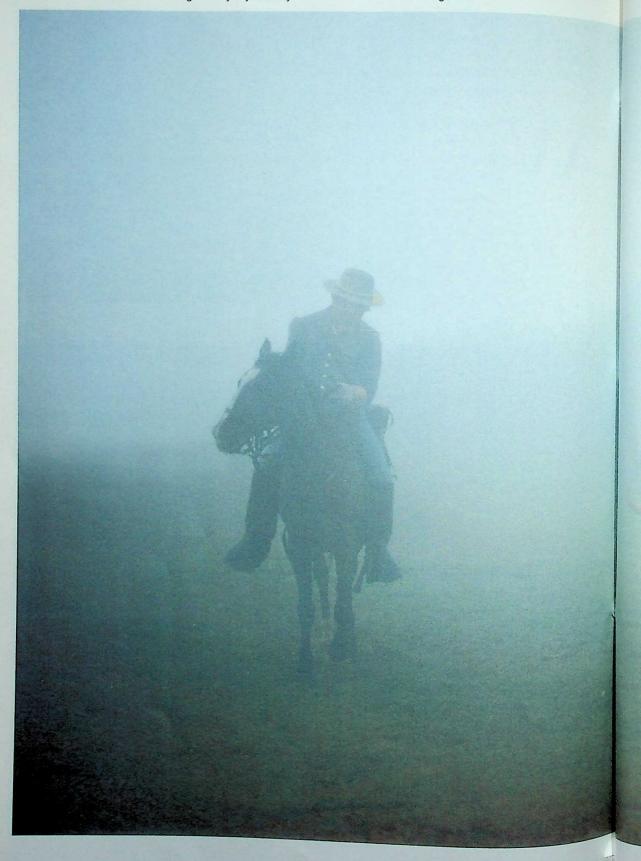
INSLOW HATED a lie," said one of relatives, summing up the essence of an unpretentious man who persisted, through trial and error, in an artistic career that lasted 50 years and produced some 2,000 known works. That legacy leaves admirers like Nicolai Cikovsky, Jr., shaking their heads in awe.

"The great thing about Homer is that there is no point in his career when he falters," says Cikovsky, a Homer scholar who is senior curator of American and British paintings at the National Gallery of Art in Washington, D.C. "He just gets better and better almost until the moment of his death. This is very, very rare. So many painters give up in their later work, have nothing new to show. Homer never had that problem."

He found fame early, but that drew unwanted attention to this shy and modest man, who hated explaining his pictures, giving autographs, or receiving visitors who interrupted his work. He withdrew deeper within himself, eventually earning a reputation, not entirely warranted, as a recluse.

Homer's insistence on privacy has made him a hard case for biographers, who have been left with no diaries, a pile of largely unrevealing





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fog of uncertainty hung over the Union when soldiers—like this horseman in a reenactment fog of uncertainty hung over the Union when soldiers—like this horseman in a reenactment near Cedar Mountain, Virginia—returned from the nation's bloodiest war. Would thousands of armed Rebels and Yankees resume their fight? Or would they look to a peaceful future? The peace held, and artists like and Yankees resume their fight? Or would they look to a peaceful future? The peace held, and artists like and Yankees resume their fight? On would they look to a peaceful future? The peace held, and artists like and Yankees resume their fight? On would they look to a peaceful future? The peace held, and artists like and Yankees resume their fight? On would they look to a peaceful future? The peace held, and artists like and Yankees resume their fight? On would they look to a peaceful future? The peace held, and artists like and Yankees resume their fight? On would they look to a peaceful future? The peace held, and artists like and Yankees resume their fight? On would they look to a peaceful future? The peace held, and artists like and Yankees resume their fight? On would they look to a peaceful future? The peace held, and artists like and Yankees resume their fight? On would they look to a peaceful future? The peace held, and artists like and Yankees resume their fight? On would they look to a peaceful future? The peace held, and artists like and Yankees resume their fight? On would they look to a peaceful future? The peace held, and artists like and Yankees resume their fight? On would they look to a peaceful future?

omer was the boy who never really grew up," says David Tatham, a scholar sizing up the man who was still playing with slingshots and scribbling on walls in his 50s. Homer toyed with his art as well, moving mountains and characters in and out of versions of works like "Snap the Whip."

Such paintings established Homer as an artist with a distinctively American eye, "as Yankee in character as the 'stars and stripes,'" wrote a contemporary reviewer, "but without a particle of vulgar forcing of that idea."

letters, and very few interviews by contemporaries who knew the man.

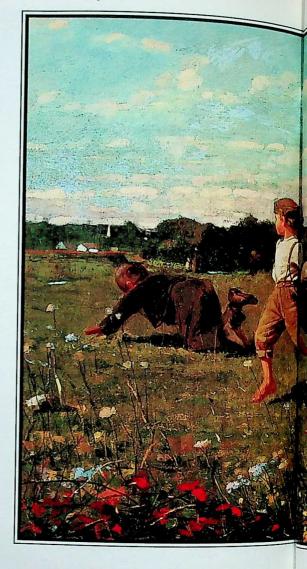
What we know is sketchy: Born in Boston in 1836, Winslow was the second of three sons of Charles Savage and Henrietta Benson Homer. She was sensitive and kind, an amateur water-color painter who encouraged young Winslow's artistic leanings. Charles was a hardware merchant, full of energy and bluster, a dreamer who lost much of the family's money in the California gold rush of 1849.

Homer started work for a Boston lithographer at 19, then moved to New York City as a freelance illustrator for *Harper's Weekly* and other magazines. *Harper's* assigned him to cover President Lincoln's Inauguration, then the Civil War. The war gave Homer his first great subject, which eventually set him on an independent artistic career.

He left New York in the early 1880s, and except for seasonal forays to the Adirondacks, Quebec, and the tropics, he lived alone in Maine with a terrier named Sam. He never married, preferring the company of working stiffs to genteel society. If he felt pressed by a social engagement, his response could be graceless:

"No, thank you," he said when asked to dine with a new neighbor in Prouts Neck, "I never dine out and I never accept invitations. I am perfectly satisfied with my own cooking." Pause. "On second thought, the fish man didn't come today. I will stay," he said to the hostess, now probably aghast at the prospect of a whole evening's conversation with the man.

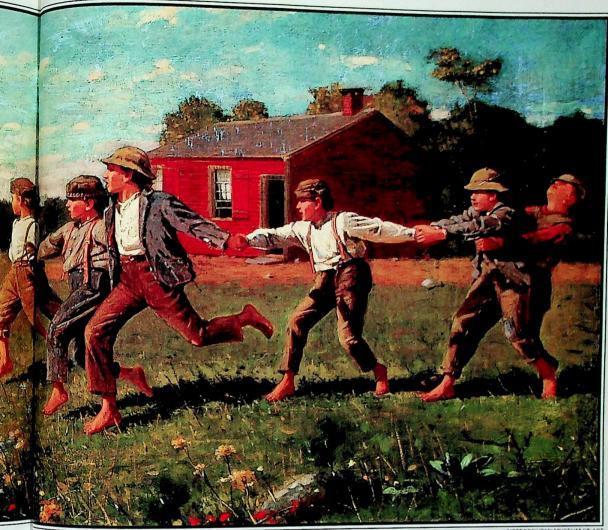
"Well, he was not the person you'd invite to a party expecting him to be the spark plug," says David Tatham, a Homer scholar at Syracuse University. "He was the quiet guy in the corner. He was extremely nonverbal—he would point



at things instead of talking about them. On the other hand, when he was with people he knew and knew well, he was very much liked for his quietness and was known to them as kind, generous, and gentle."

This other Homer, the private one, was devoted to family and friends. He looked out for their business interests in Maine, sent them paintings for Christmas, and showed them a keen wit. He mailed cartoons poking fun at himself and his pompous father. "Everything is quiet here but Father," he wrote to a cousin, "and he is like Wall Street on a 'black Friday." But Homer almost never initiated correspondence, was tardy acknowledging letters, and sometimes explained his lateness in deeply eccentric terms: Didn't have any paper, too far from the post office, the wind was blowing too hard, was building a doghouse.

According to a friend, who may have been



METROPOLITAN MUSEUM OF ART

joking, Homer's four favorite words were "Mind your own business." It was not a joke for would-be biographers. "I should not agree with you in regard to that proposed sketch of my life," he told one in 1908. "I think it would probably kill me to have such [a] thing appear. . . ." With another applicant he was more brusque: "I do not wish to see my name in print again."

four feet tall, rippling across a flag high above Fifth Avenue in New York City, announcing a retrospective at the Metropolitan Museum of Art. The Met show was the last stop on a three-city tour, which took Homer's work to the National Gallery in Washington and the Boston Museum of Fine Arts, drawing more than 600,000 visitors in 1995 and 1996.

I join a crowd sizzling on the museum steps in the July sun, waiting for opening time. We file inside and squeeze into a room that seems too hot and small, but Homer soon casts his spell, drawing people out of themselves and into the Civil War, where the exhibit begins.

Precious little bloodshed darkens Homer's war. Instead of guns and masses of soldiers, Homer focuses on individuals, behind the lines and around the corners of the action: Union soldiers listening to camp music and thinking of home, an officer sizing up captured Rebels, troops trying to get warm around a meager fire that you can almost hear hissing in the rain.

And over here a Union sharpshooter sits in a pine tree, taking aim on the enemy. His shooting eye, open wide, sights down the barrel. This new kind of warfare—impersonal, modern, chilling—allows combatants using telescopic rifles to kill one another at great

distances, up to a mile away. Homer immediately understands the implications of the technology and depicts it in "Sharpshooter." Only years later did he reveal his views.

"I looked through one of their rifles once when they were in a peach orchard in front of Yorktown in April 1862," Homer wrote to a collector, sending along a sketch with a victim caught in the crosshairs. "The above impression struck me as being as near murder as anything I could think of...."

Homer's mother said the war changed him so that his best friends did not know him. "He suffered much, was without food 3 days at a time & all in camp either died or were carried away with typhoid fever," she wrote to Winslow's brother Arthur.

When the smoke had settled, Homer had grown up, and his reputation for unwavering honesty was established. "Mr. Homer is the first of our artists... who has endeavored to tell us any truth about the war," a reviewer wrote in 1863. His paintings are "signed all over with truth." Homer never abandoned that Yankee virtue.

of turmoil and change. The bloodiest war in American history, followed by uncertainty over whether the nation would survive. Women moving into jobs once held by men. Slaves free. Tourists venturing into the wilderness. Loggers chopping woods. Electric lights appearing, along with a new notion called Darwinism, which held that all creatures, humans included, engage in a constant struggle for existence, ruled by a natural order over which they have no control.

All of these subjects appear in Homer's work, which grows bolder as we move through the show. The watercolors throb with life and feeling. The oils get larger.

The early works shine with unblemished optimism, where youths sail under clear skies and play snap-the-whip in green fields. Later canvases show the despair of man beset by nature, as in "Lost on the Grand Banks." There two gaunt fishermen strain to see a way home in killing fog. And toward the end of Homer's career, people gradually disappear, replaced by sea and rock, wind and water, light and dark.

Homer's range covers a whole world of

emotions, like those of an accomplished actor, and the New York crowd warms to him. They point. They smile and poke their noses into the paintings. They notice the hundreds of little details Homer sneaks in—the golden glow of a duck's eye, the distant blink of a lighthouse, the sunlight warm on a farmer's back, the translucent green of an ocean wave, the forgotten dog showing through thinning pigment, reunited with his master after all these years.

Homer still speaks to people across the years, but how? It may be his seeming simplicity, so forthright and easy to approach. But there is more to him than that, an intangible I'm still brooding over hours later, walking alone in New York.

Night eases down. People rush by on Park Avenue, trying to get home. A black man too old for such work pedals like mad on a bent bicycle, delivering prescriptions, encircled by cars that threaten to devour him like sharks. The Darwinian struggle persists here, along with other reminders of Homer's work.

Two women approach from the opposite direction. One lifts her face to the sky and smiles so radiantly that I spin around to see what caused it, and there it is: a yellow half-moon climbing into a black sky and, below it, lights winking on like stars. "Look at it!" she says to her friend, both smiling now under the spell of the moon. It's an urban version of Homer's "A Summer Night."

It's all here on the street, and it's all there in Homer. He endures because he painted the things that matter most: friendship, war, healing, courtship, beauty, love, the fight for survival against an uncaring nature.

HE WILL TO SURVIVE works a strange magic on some men in their 40s. They buy loud ties. They change jobs. They wear gold chains and disappear with exotic dancers. Anything to postpone the inevitable. Homer's big move came in the early 1880s, when he suddenly withdrew from New York after more than 20 years of living there, vanishing into a self-imposed exile. He was in his mid-40s, well liked and socially active. He had "the usual number of love affairs," according to a friend. A photograph from the period shows him looking sophisticated in a clipped handlebar mustache, a boldly checked suit, and flowing silk

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cravat. And the eyes-dark, deep, liquid, steady, full of confidence, belying any crisis boiling beneath the surface. But not all was well.

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"Something happened," says Cikovsky, a harrel-chested man with a shock of white hair and an easy grace Homer might have envied. "But we'll never know exactly what caused this extraordinary break. I think it was a romantic rejection, but art was involved too. You have to be cautious about blaming it all on a cruel woman who broke his heart.'

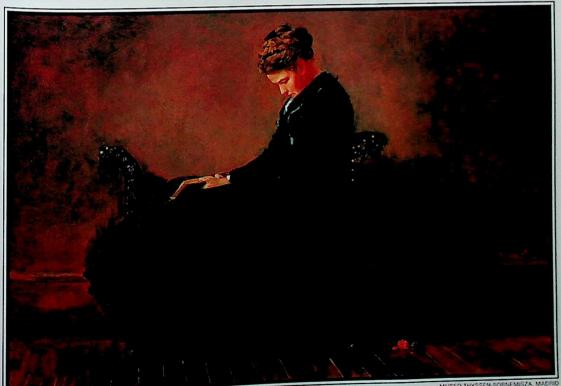
Perhaps Homer felt stale artistically and needed to go away to find fresh subjects. Generations of Homer scholars have also wondered, as Cikovsky does, about the romantic angle and have looked for clues to a "mystery woman" who may have accelerated Homer's retreat. A redhead appears in several of his postwar pieces, as do other elegant ladies who stroll the beaches, teach drawing, walk little dogs, or pose from windows. We do not know the identity of any.

All except for Helena de Kay, the rare subject of a portrait Homer painted sometime between 1871 and 1872. "We know the woman," says Cikovsky, studying the painting with me in New York, "and we know that she and Homer had some relationship, a certain closeness. We know from the bare walls and floor in this painting that it was done in Homer's Tenth Street studio."

She is dressed in black, seated on a settee, holding a closed book. Her chestnut hair neatly coiled, she looks down, as if lost in a moment of reflection. A pink rose lies on the floor behind her. What does it all mean? We don't know. And even if it were possible to ask Homer himself, he would very likely tell you that it means whatever you want, if he responded at all.

His last recorded comment about Miss de Kay comes in 1872, when he offers to return the portrait. With what has been described as "unconvincing breeziness," he asks: "Why don't

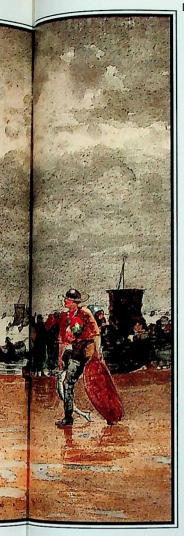
aught in a pensive moment, Helena de Kay, a socially prominent friend from Homer's New York days, seems to brood over a closed book. Symbolic of lost love? "Since it's Winslow Homer we're talking about," says Nicolai Cikovsky, Jr., a leading biographer, "we'll never know for certain." But romantic disappointment may have sent Homer fleeing New York to remain a bachelor the rest of his days.



MUSEO THYSSEN-BORNEMISZA, MADRID







omer's wanderings led him to Cullercoats, an isolated English fishing village where the North Sea serves up regular thrashings of wind and storm. Sturdy women, who might have been chiseled from basalt, walk through watercolors like "Four Fisherwives." His nearly two years in Cullercoats also gave Homer one of his great themes—the bravery of humans against cruel odds. In the same village today a view from the lifesaving station reveals an empty beach, all that remains of the fishery.

you limp into my studio . . . and take it." Then he speaks as if trying to reassure her: "I am very jolly, no more long faces. It is not *all* wrong."

Two years later she married Richard Watson Gilder, a poet who was then managing editor of *Scribner's Monthly*. She keeps the painting until her death.

"End of story?" I ask Cikovsky.

"That's it," he says, staring at the canvas for a

long moment. "Very sad."

Whatever prompts it, Homer disappears from New York in 1880, when reviewers first note his tendency to reclusiveness. He goes to Ten Pound Island, in the harbor of Gloucester, Massachusetts. There he spends the summer and sees few people. He works feverishly, experimenting with watercolors, turning out more than a hundred of them. Few characters inhabit the pieces, garish seascapes described by contemporaries as "wildly impressionistic" works of "fervid, half-infernal poetry."

Cikovsky says: "He never painted anything before or after of this intensity. They are inescapably *charged* with emotional feeling of the most intense kind."

Homer plunges into this new rhythm of life, working hard, trying new things, withdrawing even farther afield. In 1881 he pops up in the isolated English fishing village of Cullercoats on the North Sea.

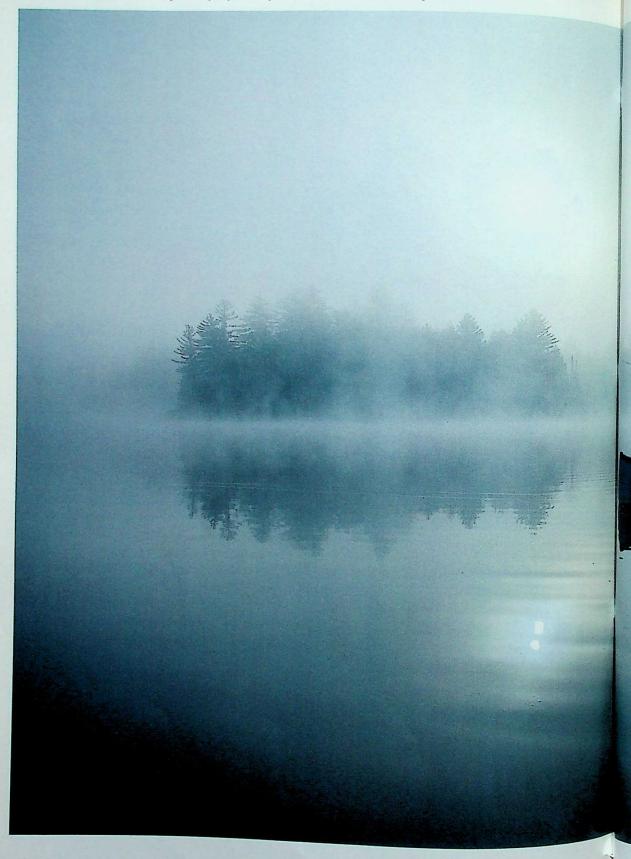
During nearly two years there Homer discovers the mature subject he will explore for the rest of his life—the place of humans in a hostile natural world, fighting big seas and threatening skies. Dories struggle out to sea, ships wreck on the rocks, rescuers row out to help them. The Cullercoats women, big and beefy and nothing like the delicate women of Homer's earlier work, dominate the scene. They haul baskets of fish to market, mend nets, and look stoically to sea, which could swallow their husbands without a burp.

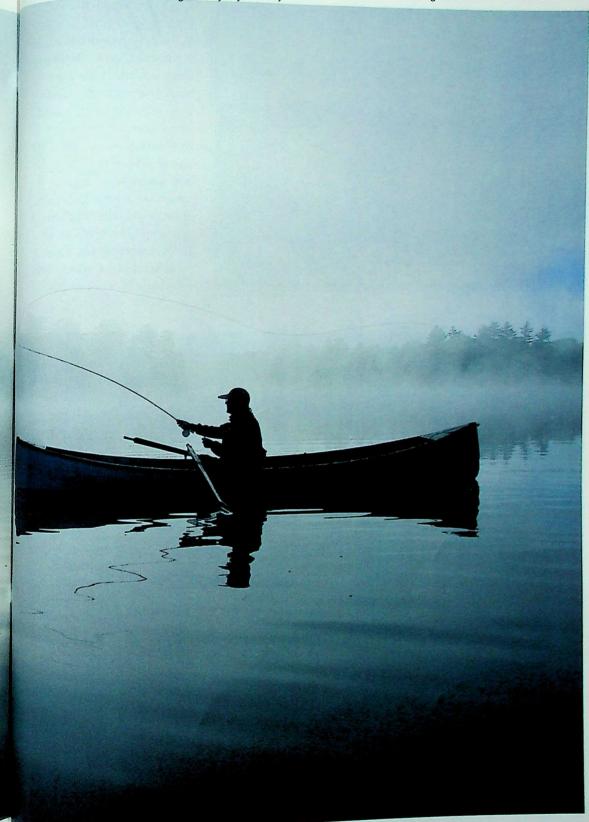
Homer returns home with a bulging portfolio of new work, and his claim on the subject is fixed. "Mr. Homer," writes the Boston *Transcript*, "is both the historian and poet of the sea and sea-coast life."

TO GET CLOSER to this new subject, Homer settles on the secluded coast of Maine at Prouts Neck in 1883. It proves a wise choice, which frees him to do the best work of his life. Few neighbors, simple living, and a most dramatic setting where nature rules with a vengeance. The rocky peninsula thrusts into the North Atlantic, as if daring the sea to take a swing at it. Winslow's whole family builds homes there: Father and Mother Homer summer at Prouts Neck, along with brothers Charles and Arthur, their wives, and children. Winslow bunks for a spell in the Ark, the big house his parents share with Charles Jr. and his wife, Mattie. But Winslow finds the social requirements too demanding and is soon refitting a nearby stable for his home and studio.

"The Studio will be quite wonderful," he writes to Mattie Homer in June 1884. "It's very strong. The piazza is braced so as to hold a complete Sunday school picknick. Charlie will be very much pleased with it."

You could pass by Homer's studio today without noticing the squat green-and-white building hugging the Maine cliffs. But with the





ith a stroke of his fly line, a fisherman parts the morning mist on Mink Pond, where Homer often fished for trout. His Adirondack excursions produced creelfuls of fish—and a hundred watercolors, which fished for trout. His Adirondack excursions produced creelfuls of fish—and a hundred watercolors, which fished for trout. His Adirondack excursions produced creelfuls of fish—and a hundred watercolors, which testify to Homer's work habits. "Talent!" he scoffed to an admirer. "What they call talent is nothing but testify to Homer's work habits. "Talent!" he scoffed to an admirer. "What they call talent is nothing but testify to Homer's work habits. "Talent!" he scoffed to an admirer. "What they call talent is nothing but testify to Homer's work habits. "Talent!" he scoffed to an admirer. "What they call talent is nothing but testify to Homer's work habits. "Talent!" he scoffed to an admirer. "What they call talent is nothing but testify to Homer's work habits. "Talent!" he scoffed to an admirer. "What they call talent is nothing but testify to Homer's work habits. "Talent!" he scoffed to an admirer. "What they call talent is nothing but testify to Homer's work habits. "Talent!" he scoffed to an admirer. "What they call talent is nothing but testify to Homer's work habits. "Talent!" he scoffed to an admirer. "What they call talent is nothing but testify to Homer's work habits. "Talent!" he scoffed to an admirer. "What they call talent is nothing but testify to Homer's work habits."



MUSEUM OF FINE ARTS, BOSTO

y grandfather knew the man well," says Leila Wilson, nodding toward trout likely caught and mounted by Homer. In the Adirondacks he produced lyrical watercolors. "The Blue Boat" captures the perfection of a summer's day. Homer's idylls left behind some yarns: about his fondness for strong drink, the inevitable fish tales. "Everyone has a story," Mrs. Wilson recalls. "I don't know if my Uncle Roy really baited Homer's hooks, but he certainly liked to say he did."

help of Phil Beam of Bowdoin College and Doris Homer, a niece still living at Prouts Neck, I find the old stable on a September afternoon that gives a foretaste of winter. The weather shifts through several moods, sending shadows and sunlight tumbling across Winslow's lawn. The salt air smells of driftwood and seaweed from the beach, where crows swing out of the junipers and sail off gossiping on a stiff wind.

"From here," says Beam, "Homer could see for miles across the ocean, all up and down the coast."

This was Homer's world, a place that became for him what Yoknapatawpha County was for William Faulkner, a postage-stamp universe distilled and brought to life by the artist's imagination.

"That I am in the right place at present there is no doubt about," he wrote to his brother Charles in 1899. "I have found something interesting to work at, in my own field, & time & place & material in which to do it."

Homer spent hours walking the coast in all kinds of weather, accompanied by Sam the terrier and watched from a distance by his father, who trained a spyglass on the artist and reported his movements to anyone within hearing.

Winslow loved it best when winter came barreling in and forced the summer people to leave. That meant fewer distractions from work, and he kept busy building fires, tromping in the snow, watching the temperature drop, and cheerfully reporting on the rigors of winter in the north country.



"I have been free here for four days," he distance," recalls Dori wrote in December to M. Knoedler & Co., his art dealers in New York, "the last tenderfoot having been frozen out, & now out of gun shot of any soul & surrounded by snow drifts, Lagain take up my brush after nine months of loafing."

AMILY AND FRIENDS gave Winslow a wide berth when he was working, knowing how single-minded he became in the grip of an idea. He kept the studio door shut, ate alone, took long walks, and paced his porch like Captain Ahab, "wearing out the balcony," as one of his brothers put it.

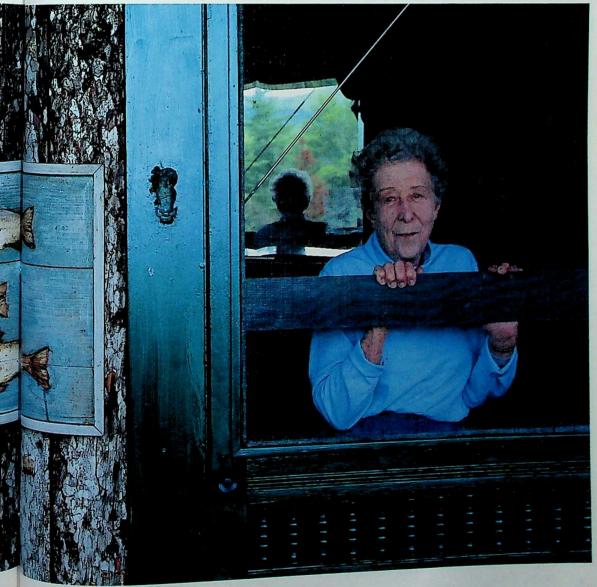
"All of the Homers lived within spitting

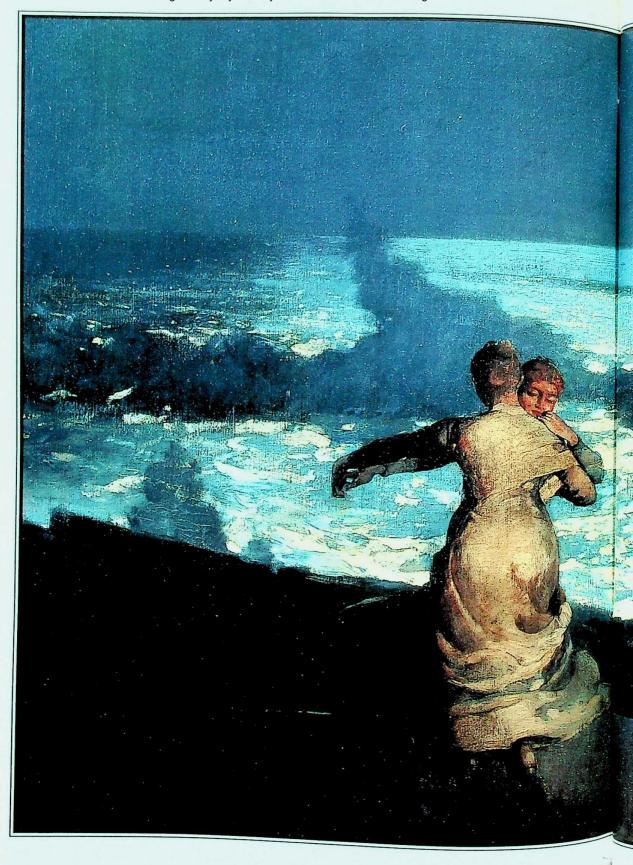
distance," recalls Doris Homer, who was married to Charlie Homer, son of Winslow's brother Arthur.

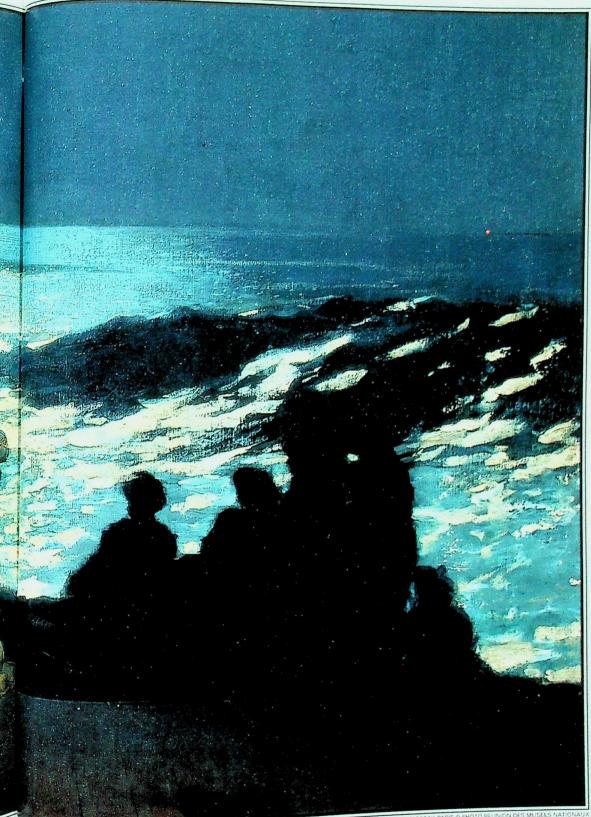
"I think they enjoyed each other very much. They fished together and kept in touch. It was a close family," says Doris.

"How do you think Winslow would like all this new attention?" I ask, noting that hundreds of visitors came to see the studio in a recent year.

"Well, he liked his privacy," says Doris. "This is just a bachelor guy who lived the way he wanted. So I think the attention would bother him. But he would appreciate the recognition. People tried to make him out as an ugly old man, but I've always heard them say his manners were as fine as silk."

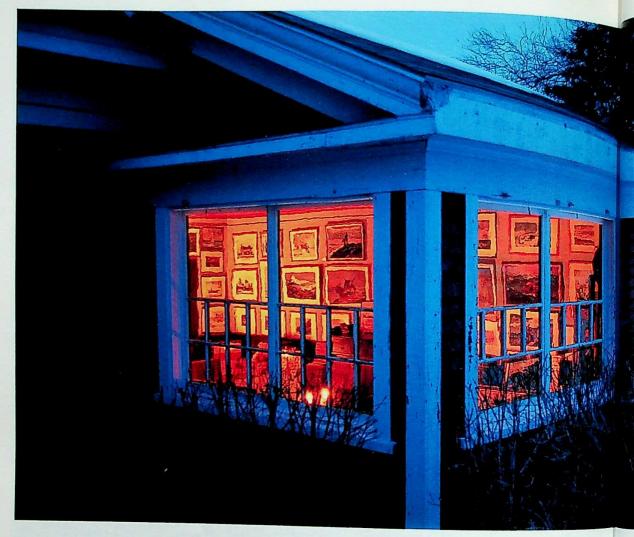






MUSEE D'ORSAY, PARIS © PHOTO REUNION DES MUSEES NATIONAU.

omer had a front-row view of the eternal war between sea and shore at Prouts Neck, Maine. Yet omer had a front-row view of the eternal war between sea and shore at Prouts Neck, Maine. Yet omer had a front-row view of the eternal war between sea and shore at Prouts Neck, Maine. Yet omer had a front-row view of the eternal war between sea and shore at Prouts Neck, Maine. Yet one peace broke out when girls danced under the moon in "A Summer Night." Other paintings originated under peace broke out when girls danced under the moon in "A Summer Night." Other paintings originated under peace broke out when girls danced under the moon in "A Summer Night." Other paintings originated under peace broke out when girls danced under the moon in "A Summer Night." Other paintings originated under peace broke out when girls danced under the moon in "A Summer Night." Other paintings originated under peace broke out when girls danced under the moon in "A Summer Night." Other paintings originated under the moon in "A Summer Night." Other paintings originated under peace broke out when girls danced under the moon in "A Summer Night." Other paintings when Homer, sitting the influence of moonlight—Economic paintings of the painting o



We're sitting inside the studio in a boxcarsize room Homer called "the factory." It seems quite dark inside, but Doris reminds me that Winslow started most of his pieces outside in the sunlight, using this room to complete them. The place was spartan, almost barren. He cooked meals over a fireplace in the next room, using old-fashioned kettles. He scribbled notes to himself on the walls.

"What a friend chance can be when it chooses," says one such note, scrawled in pencil.

Although Homer lived simply, he lived very well, shipping provisions up from Boston—Canadian mutton, chickens, Edam cheese, vatted whiskey, and, one of his favorites, Jamaica rum.

"You do not eat enough or drink enough," he once wrote to Charles, pointing out that it was cheaper to live in Maine than in New York. "[I have] all these good things . . . which you go without and eat corned beef and cabbage."

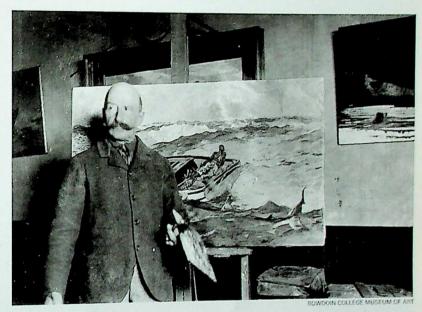
Living so far from civilization, Winslow kept supplies in quantity, so that he would never come up short. He hoarded crates of grapefruit and oranges, barrels of cider, bottles of ale, and kerosene stoves (he had five). He bought a new pair of pants every month. He ordered underwear by the gross—144 pairs of socks at a time. When one of his brothers questioned this practice, Winslow was ready with an answer: "When will you learn that the time to buy a thing is when you find what you want? If you go back the next year and try to get more, they will try to sell you something else."

Phil Beam, 88, is the same age as Doris, and one of the few living links to Homer. He takes me scrambling over the rocks to see where Homer painted—here Cannon Rock jutting out into the surf, booming when the tide rushes under it; there a frail boat with two fishermen pitching among the waves; here the white foam tickling a submerged bar; there the

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And Property.

y home here is very pleasant," Winslow wrote to brother Charles in 1898, describing the stable he had converted into living quarters and studio at Prouts Neck. "I do not wish a better place." Bathed in thin winter sunlight, the place appears today much as it did in Homer's time. He found sanctuary there, lavishing hours on projects like "The Gulf Stream," a 15-year venture seen in this rare photograph of Homer at work. During his Maine years Homer spurned unwanted visitors and earned his reputation as a recluse. He was unapologetic. "This is the only life in which I am permitted to mind my own business," he wrote a friend. "I suppose I am today the only man in New England who can do it."



rafts of black ducks huddled in swells as the weather closes on them.

"He would work at a painting in stages, turn it over in his mind, work at it some more," says Beam. "If it didn't come out right, he'd drop it for a while and wait. He was persistent and patient. I'll tell you what," he says, giving me a friendly punch on the shoulder, "he didn't leave a lot of unfinished work behind."

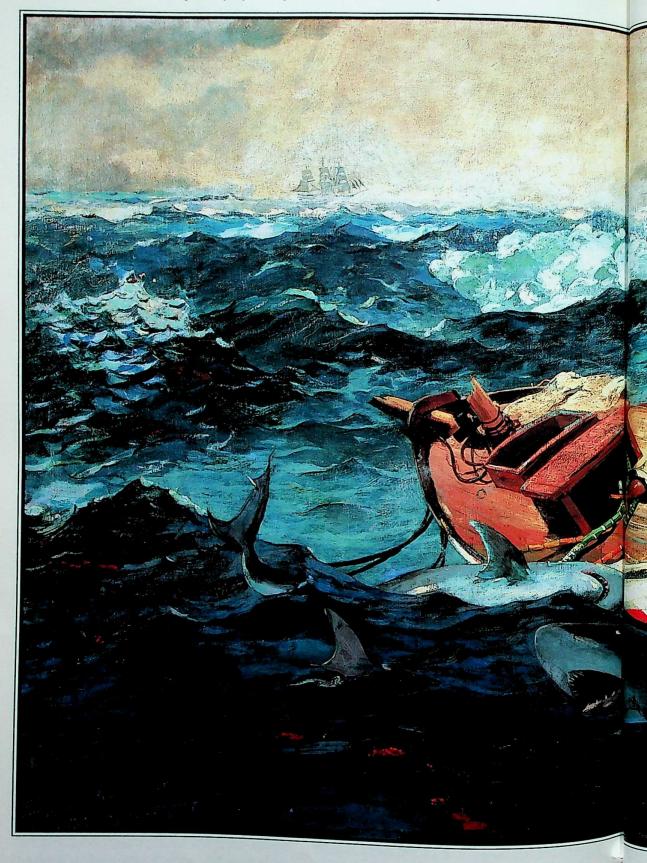
One of Homer's most famous oils, "The Gulf Stream," was 15 years in the making. Other works waited for months or years, as Homer noted in 1902, writing to his art dealers in Chicago: "It will please you to know that, after waiting a full year, looking out every day for it . . . on the 24th of Feb'y, my birthday, I got the light and the sea that I wanted; but as it was very cold I had to paint out of my window, and I was a little too far away,—and although making a beautiful thing—it is not good enough yet, and I must have another painting from

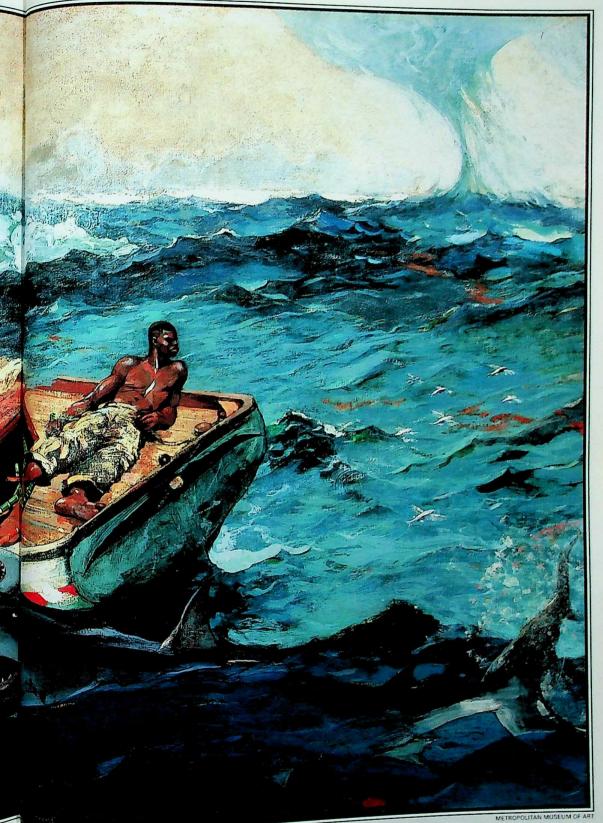
nature on it." Eight months later, he finished the long-awaited work, "Early Morning After a Storm at Sea," and shipped it.

seem effortless and simple today. But the more time you spend with Homer's work, the more complex it becomes, full of details you didn't notice the last time. You get the feeling that you are walking into the middle of an unfolding tale and find yourself filling in the next stage, off the canvas.

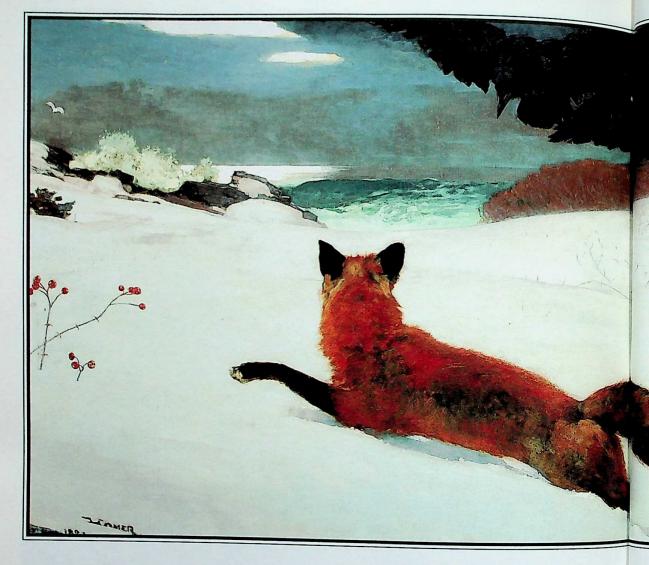
What happens to the brook trout leaping clear of the water? Does the hook give way? Or the deer swimming across a blue pond on a glorious October day, pursued by hunter and hound. Does the buck escape? What did that guide hear that caused him to turn his head away from the viewer?

"The outcome is always in doubt," says David Tatham of Syracuse University. "Homer





he Gulf Stream," completed in 1899, based perhaps on a derelict sloop Homer had seen in the Caribbean years before, stands as a bookend to the sunny optimism of "Breezing Up," painted early in Caribbean years before, stands as a bookend to the sunny optimism of "Breezing Up," painted early in Caribbean years before, stands as a bookend to the sunny optimism of "Breezing Up," painted early in Caribbean years before, stands as a bookend to the sunny optimism of "Breezing Up," painted early in Caribbean years before, stands as a bookend to the sunny optimism of "Breezing Up," painted early in Caribbean years before, stands as a bookend to the sunny optimism of "Breezing Up," painted early in Caribbean years before, stands as a bookend to the sunny optimism of "Breezing Up," painted early in Caribbean years before, stands as a bookend to the sunny optimism of "Breezing Up," painted early in Caribbean years before, stands as a bookend to the sunny optimism of "Breezing Up," painted early in Caribbean years before, stands as a bookend to the sunny optimism of "Breezing Up," painted early in Caribbean years before, stands as a bookend to the sunny optimism of "Breezing Up," painted early in Caribbean years before the caribb



felt that viewers had an obligation to participate in the painting. So he resisted, sometimes very impolitely, requests to explain his paintings. His point was to raise more questions than answers."

Homer was especially sensitive to questions about "The Gulf Stream," perhaps because he spent so long creating the piece. It depicts a black sailor languishing on the deck of a dismasted sloop, surrounded by sharks. The sea seems splashed with blood. When a dealer in New York asked for an explanation, Homer's response was unusually acerbic:

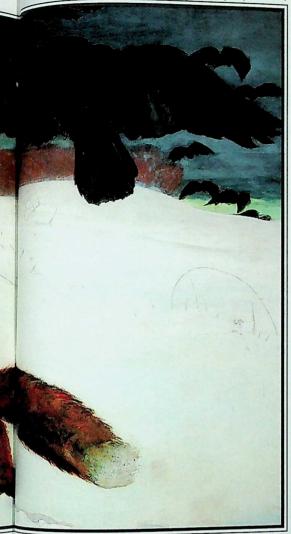
"Regret very much that I have painted a picture that requires any description. . . . You can tell these ladies that the unfortunate negro . . . will be rescued & returned to his friends and home & ever after live happily."

If this Homer was sometimes testy with strangers, the other Homer developed an easy

relationship with his hardworking neighbors, whose lack of airs and native terseness matched the artist's style.

Homer often hired locals to pose for him. Will Googins, a Prouts Neck fisherman, rowed a dory out into rough water and fired a shot-gun between the waves so that Homer could study how the blast would look from a duck's point of view. The result, "Right and Left," was one of Homer's last oil paintings.

A few natives were even trusted enough to visit Homer's studio, where they got the rare chance to criticize his finished work. Elbridge Oliver, the stationmaster at Scarborough, took one look at the birds in "Fox Hunt" and spoke right up: "Hell, Win," he said, "them ain't crows." Homer silently took up his brush, painted the birds out, and accompanied Oliver to the Scarborough train station, where they baited crows with corn for three days. Watching



PENNSYLVANIA ACADEMY OF FINE ARTS, PHILADELPHIA

closely, Homer sketched the birds on telegram blanks and returned to the studio to try again.

Much of Winslow's time was taken up with the care of his father after his mother's death in 1884. It fell to Winslow, the family's only unmarried son, to look after the patriarch.

and a tendency to press them on others. He grows his white hair in long curls so that he will look like an Old Testament prophet. He insists on shaving with rainwater from a special barrel. He makes a scene over the food served at dinner ("I had rather have a flogging than that!"). He fixates on the Spanish fleet, which he becomes convinced is about to invade the United States on the Maine coast, of all places. He bombards Washington, D.C., with warning cables until the Spanish-American War ends.

unter becomes prey in one of Homer's great nature paintings, "Fox Hunt." Crows, pushed to desperation by a hard winter, drive a fox through deep snow on the Maine coast, tiring it to the point of exhaustion and death.

Homer identifies with the fox—he buries his signature deep in the snow, so that his name struggles like the doomed animal. Homer's works, at first glance so simple, gradually reveal such layers of irony, surprise twists, and new meaning—all reasons his art endures.

Winslow takes it all in good humor, even when his father begins preaching abstinence and joins a temperance group. Winslow's drinking habits include the tradition of a New England bracer at 11 a.m. each day. He invites his father to join in this morning drink, and each day brings the same routine:

"Now, Father, don't you think you'd better take this?" Winslow asks, offering a drink. "It will do you good."

"Any alcoholic liquor in that, Winslow?"

"Yes, Father."

"Well, I won't touch it then."

"Father, if you don't take it, I'll drink it myself."

"Well, Winslow, rather than have you destroy the tissues of your stomach by drinking this alcoholic beverage, I'll drink it."

As time goes on, the two aging bachelors find that they need each other. Father grows anxious when Winslow is out of sight, and Winslow worries about whether Father is eating properly. To his surprise, Winslow discovers what most sons eventually see—something of their fathers in themselves.

"I find that living with Father for three days, I grow to be so much like him that I am frightened," he writes to Mattie. "We get as much alike as two peas in age & manners."

Winslow's father dies at age 89 in 1898, leaving land (and precious little else) to the family. The land rentals supplement Winslow's income from art. And he makes a decent living by watercolors, which can be painted faster and sold more cheaply than oils.

"I will live by my watercolors," he once told a friend. Not only did they help pay the bills, but they also bought the time needed to treat bigger themes in oils. Even after Homer settled in Prouts Neck for good, he continued to travel each year, visiting the tropics in winter and the North Woods in summer, fishing and painting in both places. Homer found good subjects on such trips and depicted them in watercolors, which were easier to handle for the traveling artist.

"All of the known techniques of watercolor painting he knew and mastered," says David Tatham, a precise, neatly pressed man who speaks in the frugal cadence of his native New England. Tatham recalled the ways Homer manipulated the medium. He would sand down the wash to show the pigment beneath, or use a sharp point to cut through paint to depict the arabesque of a fly line in the exposed white paper. He would wet a finished piece and blot the colors to create the look of a dense forest.

"No one in America had done many of these things before," says Tatham. "You might say he was at the cutting edge of technique."

watercolors are works inspired by the Adirondacks, where the artist made frequent visits over 40 years. An avid fly fisherman, Homer often stayed at the North Woods Club, a 4,700-acre preserve in Essex County, New York. Even today, the years fall away as you drive along the shadowy road from Minerva to the North Woods Club.

"I don't think much has changed since Homer was here," says William H. Savage, a North Woods member who joins others in the old dining room at night to share a drink and tell stories about the day's fishing. The atmosphere is relaxed, the cabins rustic and without pretense, which Homer no doubt appreciated.

"He did his best work in places like the North Woods Club and Prouts Neck," says Tatham. "These were places he loved to be, secure among his friends and family."

Now as in Homer's day, you row out on Mink Pond through curtains of fog and see the distinctive Adirondack guide boats that skim through so many of Winslow's watercolors. One of the best loved, "The Blue Boat," captures the tranquillity of a perfect summer's day, when nature smiles on two guides drifting through a spattering of lily pads and pickerelweed, the mood so quiet that you can almost hear trout sipping flies in the next county.

Such works-striking in their vivid color

and spontaneity—speak eloquently of nature's soothing power. But Homer's long years in the Adirondacks also taught him how hard life was in the mountains. The settlers here chopped trees, trapped animals, fished for meat, and hunted to feed their families. Starvation and death were never far away, so the people had to be resilient, the landlocked equivalent of the fishermen Homer so admired on the coast.

A sense of loneliness haunts many of his Adirondack works, the big woods and empty spaces dwarfing the humans, a reminder of man's place in the natural order. This idea comes into sharp focus in "Huntsman and Dogs," an oil in which Homer depicts a young hunter in a barren landscape, carrying a deer's skin and rack, surrounded by baying hounds.

"Every tender quality of nature seems to be frozen out of it, as if it were painted on a bitter cold day, in crystallized metallic colors on a chilled steel panel," wrote Alfred Trumble, a critic reviewing the work in 1892.

Despite such complaints, Homer continued his exploration of the Darwinian theme, portraying hunter and hunted, bird and fox, man and duck, man and fish, man and deer.

Ultimately, Homer himself yielded as well, pursued and hunted down by time. At 72 he suffered a mild stroke, which affected his muscle control and vision. He quickly recovered, resumed painting, and kept brother Charles apprised of his progress.

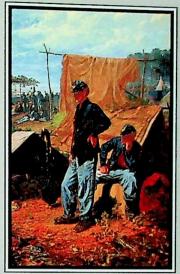
"I shall be able to shave very soon," he wrote a few weeks after the stroke. "I can paint as well as ever. I think my pictures better for having one eye in the pot & one in the chimney—a new departure in the art world."

The self-deprecation was typical, along with Homer's habit of assuring the family that he was thriving in isolation at Prouts Neck.

But Homer was ailing. By August of 1910 a visitor noticed that Winslow was in pain, from chronic stomach problems. His sight was failing. He stopped painting. He took to bed but remained ornery to the last, refusing to die "until he was good and ready," as one of his brothers put it. The end came on September 29, from a heart attack. He was 74. Charles and Arthur were with him in the place he loved most, at the best time. Winter coming, tourists gone, and just down the lawn, ocean and rocks starting another noisy argument that might have been worth painting.

Winslow Homer's Enduring Value

hen Homer began his career as an independent artist, he offered two Civil War oils for sale, but there were no takers. So Homer's brother Charles secretly bought both, reportedly paying a modest sum and hiding them so that Winslow would keep painting. A few years later Winslow discovered his brother's deception and refused to



in 1998 when Microsoft's Bill Gates paid over 30 million dollars for "Lost on the Grand Banks" (center)-making it the most expensive American painting yet sold and drawing skeptical fire from Doris Homer, a relative (bottom).

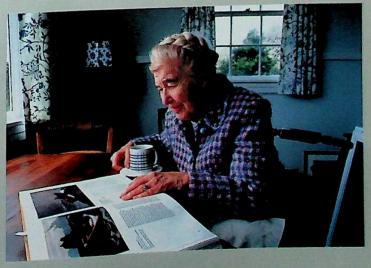
"Not worth it!" she says, proving that the family penchant for thrift and frank speech still thrives on the coast of Maine.



speak to him for weeks. By then, though, the young artist was on his way. His works were selling steadily. Watercolors brought a few hundred dollars each in Homer's late career, oils as much as \$6,000.

Those prices have zoomed in recent years with renewed interest in Homer. "Home, Sweet Home," a Civil War oil (top), sold for 2.64 million dollars in 1997 to the National Gallery of Art.

That record was shattered





Body Beasts NO MAN IS AN ISLAND. HE IS AN ECOSYSTEM. In nightmarish proportions, a common

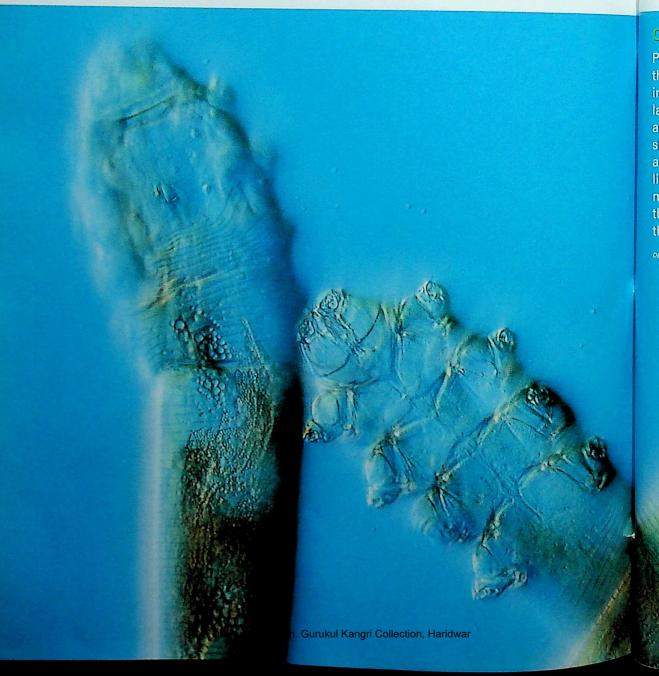
In nightmarish proportions, a common bedbug appears poised for a blood meal, compliments of a human host. Countless organisms live and feed on us. For some, we're their mainstay; for others, we're just fast food.

he habitat was deeply inhospitable—a sheer bluff, knotted and furrowed by subsurface tremors, intermittently flooded, buffeted by winds, burned by the sun. My guide was Cliff Desch, a mild, likable University of Connecticut

professor with unruly gray hair winging out over the tops of his ears. We were searching for life on the human body, or more precisely, on the hostile terrain of my own forehead. I took a bobby pin, as instructed, and scraped the crook of it hard across the skin in front of my hairline. Then, like a fisherman emptying his nets, I spread my catch on a glass slide.

The human body, especially the face, is the natural habitat for two species of mites, Desch

said, as he placed the slide under a microscope. One species is minutely adapted to the hair follicle. The other ensconces itself in the microhabitat of the sebaceous gland, less than a millimeter away. Sir Richard Owen, better known for naming another buried life-form, the dinosaur, brought the follicle mite to the attention of the world in the 1840s. He called the genus *Demodex*, meaning "lard worm" (though mites are actually distant relatives of spiders).



By RICHARD CONNIFF

Photographs by DARLYNE A. MURAWSKI

Desch peered through the microscope and said, "Oh wow" and then, "Hunh!" It appeared that my forehead was home to only one species of mite. But quickly, before I could become despondent about inadequacies in my personal biodiversity, he added: "You've got the best population I've ever seen."

It occurred to me first that Desch had spent an entire career looking at this sort of thing and second that I had stood under a shower

just a few hours earlier, slathering my forehead with soap and blasting it with steaming water. "Look at 'em all," Desch was saying now,

unable to suppress his delight. "Holy moley!"

Well, no man is an island. He is an ecosystem, though we studiously pretend otherwise. Our skin—two square yards of it on the average human body—is a habitat for roughly as many bacteria as there are people in the United States, for fungi and viruses, and on occasion for mosquitoes, fleas, bedbugs and kissing bugs, blackflies and botflies, lice, leeches, ticks, and scabies mites, which tunnel across the

backs of an afflicted person's hands like moles burrowing in the front lawn.

In the developed world we like to think we have tubbed and scrubbed ourselves free of any overly personal connection to the natural world. Even mosquitoes stay mainly on the other side of our window screens. But this is a delusion, as follicle mites, which live on almost everyone,

abundantly demonstrate.

I stepped up to the microscope, and they came into focus, lying crisscross like sticks of wood. The adult mites were about a hundredth of an inch long. Their stumpy little legs wriggled and twitched as in a dream. They had tiny claws and needlelike mouthparts for consuming skin cells. Here and there were eggs shaped like arrowheads and juveniles with angledback scutes on their underbellies, like fish scales, the better to anchor themselves in my skin. Desch eyed my forehead as if it were the Grand Banks in high season and said, "I think it's great." I smiled wanly.

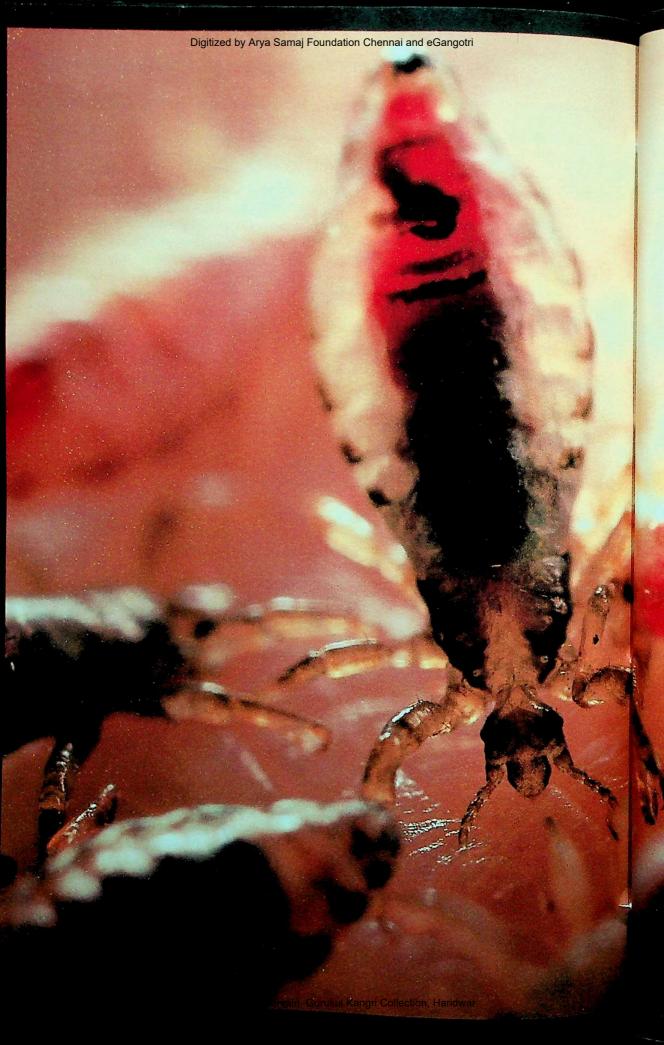
NCE UPON A TIME we were all far more at home, though not necessarily any happier, with the idea of being infested. A 15th-century courtier once discreetly picked a louse off King Louis XI of France, and the king graciously remarked that lice remind even royalty that they are human. (Next day an imitator pretended to find a flea on the king, who was by then perhaps tired of being human. "What!" he snapped. "Do you take me for a dog, that I should be running with fleas? Get out of my sight!")

Calling humans home

Permanent residents, these mites live mainly in the follicles of the eyelashes, forehead, and around the nose, their slender shape ensuring a perfect fit. Feeding on live skin cells, a single mite is about one-fourth the size of the period at the end of this sentence.

DEMODEX FOLLICULORUM, ABOUT 1,000 X





Digitized by Arya Samaj Foundation Chennai and eGangotri Dinner's on us Bloodthirsty body lice vie for space on a bared wrist. Spread by human contact, body lice-a species different from head lice-are most often found on people who neglect personal hygiene. CC-0. In Public Domain. Gurukul Kangri Collection. Ha

For almost all our history as a species, being infested was an inescapable fact of life, and our forebears achieved an intimacy with nature that we can scarcely imagine. European lovers of the 17th century sometimes wrote seduction poems about a girlfriend's fleas. John Donne once petulantly complained that a flea, having bitten boy and girl alike, "swells with one blood made of two / And this alas is more than we would do." A few gallant French lovers actually plucked a flea from their lady love and kept it as a pet in a tiny gold cage at the neck, where it could feed daily on their own blood. In Siberia, according to one story, an explorer was disconcerted to find that young women visiting his hut tossed lice at him; it turned out to be their way of expressing amorous intentions.

Clearly, this would not be a successful dating strategy today; for one thing, the human flea itself has almost vanished from modern homes. The hardier cat flea has replaced it, but only partly. Body lice, too, are far more scarce; they lay their eggs in our clothing, an elegant adaptation to human hairlessness, but have thus fallen victim to that environmental cataclysm, the rinse cycle.

have become, the more horrifying they seem to be. Moreover, science has made this horror seem rational by demonstrating over the past century that several of our ectoparasites are the most dangerous animals on Earth. The diseases they carry have killed us by the hundreds of millions—fleas with bubonic plague, body lice with epidemic typhus, mosquitoes with yellow fever and malaria. They vex and panic us even in the most modernized countries with maladies like encephalitis, transmitted by mosquitoes and ticks, and tick-borne Lyme disease.

We go to sleep at night aware that our very pillows are home to thousands of dust mites—which, as it happens, help keep our homes clean by busily consuming the tens of millions of skin cells we shed each day. But the mites also cause asthma in some people, and when it comes to the beasts that live on and around

RICHARD CONNIFF, a frequent contributor, is the author of Every Creeping Thing: True Tales of Faintly Repulsive Wildlife. Darlyne A. Murawski, who enjoys photographing very small creeping things, is a research associate at Harvard University.

our bodies, we tend to focus on the negative.

So it takes an almost unnatural objectivity to suggest that our ectoparasites can also be fascinating. Like any species colonizing difficult terrain, they have adapted ingeniously to our flesh. They use sophisticated chemosensors to find us; saws and scalpels to penetrate our skin; siphons and a small pharmaceutical warehouse, including anesthetics and anticoagulants, to steal a blood meal and get away undetected. If we can suspend for a moment the uneasy awareness that all this evolution is geared to extracting our blood, and if we can forget that our parasites mostly use this blood to

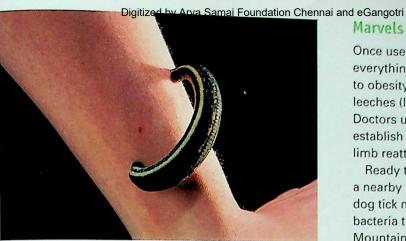
produce the eggs for their future pestiferous generations, then it is possible to regard them with awe.

They are capable of extraordinary subterfuge. For example, the adult botfly of Middle and South America manages to parasitize us quite gruesomely without ever actually making physical contact. To avoid being swatted by some balky human or other host, she captures an insect, a mosquito for example, glues her eggs to her prisoner's abdomen, then sets it free.

The mosquito ignores the eggs (as will we for a moment) and goes off to employ subterfuges of her own. Many mosquitoes feed at night, for obvious reasons ("Consider the outcome if you were to approach an elephant with a syringe," one entomologist says). But this mosquito is a day feeder, finding a victim with her eyes and with sensors attuned to carbon dioxide, warmth, lactic acid, and other bodily emanations.

Having deftly touched down, the mosquito stabs and saws her way into the





HIRUDO MEDICINALIS

Marvels and menaces

Once used for treating everything from laryngitis to obesity, medicinal leeches (left) are back. Doctors use them to help establish circulation after limb reattachments.

Ready to attach itself to a nearby leg, an American dog tick may carry the bacteria that cause Rocky Mountain spotted fever.



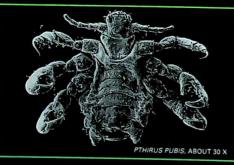


This oil-loving yeast causes pityriasis versicolor, scaling and discoloration of the skin and scalp.

The Human Habitat

A landscape of skin, hair, and nails, our bodies harbor a population of parasites that evolved along with us. Adapted to specific body regions, some are so benign as to go unnoticed. Other more harmful organisms must continue adapting to survive our efforts to destroy them.

SCANNING ELECTRON MICROSCOPE IMAGES PHOTOGRAPHED WITH THE ASSISTANCE OF THE HARVARD MUSEUM OF COMPARATIVE ZOOLOGY



Spread mainly by sexual contact, this insect uses crablike claws to move through coarse hair, usually in the pubic region.



Thriving in the warm, moist environment created by shoes and socks, this fungus is a common cause of athlete's foot.

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Stealthy opportunists

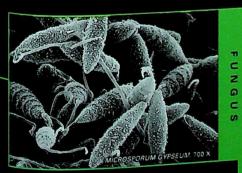
Thousands of emerald eye facets give the greenhead fly a visual advantage in tracking its target. It then strikes the victim with scissor-like mouthparts that tear flesh and suck blood.

Chemical detectors and sensitivity to motion help the leech locate its host, suction itself into place, and, with three cutting plates, withdraw a blood meal.



GREENHEAD FLY





Found in keratin-rich soil throughout the world, this fungus produces an infection called ringworm on smooth areas of skin and on the scalp.

fine web of blood vessels in the skin. The damaged vessels instantly attempt to plug their leaks with aggregating platelets in the blood. But host and parasite have evolved together, with all the one-upmanship of any arms race. So the mosquito is equipped with a powerful enzyme in her saliva to disable the platelets. The more saliva she pours down one tube in her proboscis, the faster she can suck up blood through another. Humans in turn have an immune response to the saliva, which alerts us with itching and swelling, but only after about a minute. We swat ploddingly—and are likely to kill only the slowest feeders. Thus we do our bit for natural selection, helping ensure that future generations come only from mosquitoes that are quick enough to get away with our blood in a minute or less.

on the human ecosystem is even more disheartening than all this might suggest. The mosquito may leave behind other gifts, along with her saliva. After having been driven out in midcentury, malaria and dengue fever have lately begun to reappear in the United States and other developed nations. Insect-borne diseases are on the increase worldwide, largely because so many species have developed resistance to insecticides and their pathogens have developed resistance to our best medical therapies.

In the New World tropics the insects may arrive bearing not just agents of disease but at least one other gift: Let's say we get bitten by the mosquito that was briefly held prisoner a few days earlier by a botfly. As the mosquito feeds, our own body heat triggers the botfly eggs glued to her abdomen to hatch. A botfly larva promptly crawls into the fresh bite wound, where it matures with time into the ripest sort of traveler's horror story.

The larva has a segmented, yellow-brown Michelin-man body, belted with rows of raked-back spines for lodging itself mouth first in the skin. It also anchors itself with two tusklike hooks sticking out from the mouth. Its tail is a breathing tube, which can lift up, periscope-like, just above the surface at the point of entry. As it develops, the larva wriggles visibly and painfully under the skin. Removing the botfly is relatively simple (one remedy involves applying bacon to the breathing hole,



Scratch and sniffle

Skin-melting enzymes help a scabies mite (below) burrow in to lay eggs. Feces and saliva from the mites cause terrible itching that worsens when scratched. we

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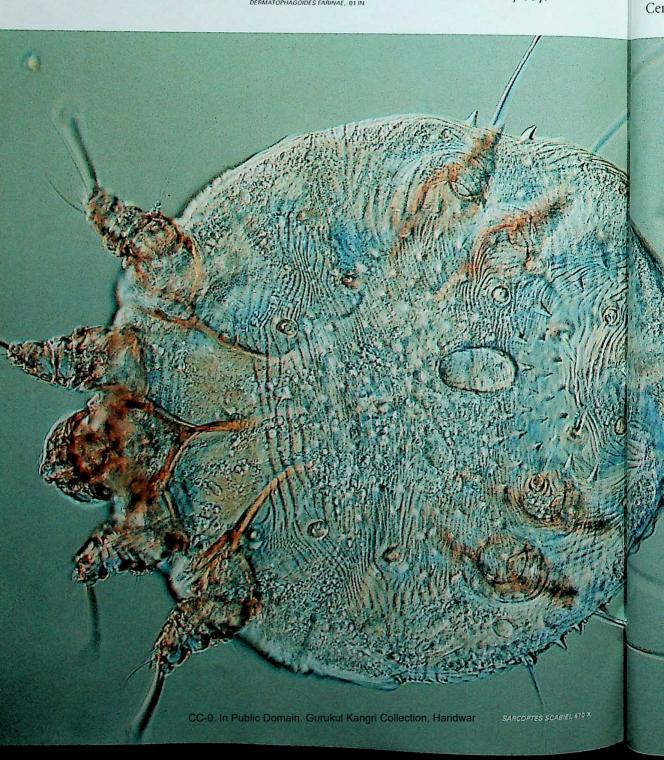
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Irritating in their own way, dust mites (left) can cause sneezing and coughing as they feed on the tens of millions of skin cells we shed every day.



we know which diseases our parasites carry to newborns as naturally as mother's milk. and how to avoid them; and at least in the more temperate corners of the planet, we don't generally suffer from nightmarish stuff like botflies. Scientists have demonstrated persuasively that our ectoparasites do not transmit the AIDS virus. And though pathogens and parasites can adapt rapidly, our body beasts appear unlikely to cause new plagues in the developed world anytime soon."We have better hygiene, screen windows, air-conditioning," says Duane J. Gubler, who heads the division of Vector-Borne Infectious Diseases at the U.S. Centers for Disease Control and Prevention.

> "Television has made us reclusive, at home at the time when we are at greatest risk of being bitten by mosquitoes."

> We are spared by being couch potatoes, each of us a lonely and underpopulated habitat, perched before our television sets, with only our resident bacteria and those lowkey hangers-on, the follicle mites, for company.

I thought about all this as I looked through the microscope in Cliff Desch's laboratory. I also thought, as so many of us do in moments of aesthetic and personal Martha about doubt, Stewart, who has written "I have always been inspired by nature." I asked Desch what sort of inspiring things the follicle mites might be doing on her forehead and by extension on riffraff like me.

These mites, he said, aren't much good at crawling to new territory. But they spread from person to person when we nuzzle, and because a population thrives in the area around the nipples, they also pass

An immigrant mite makes itself at home on a fresh face almost instantly, crawling mouthfirst into the nearest follicle, with its back to the hair shaft and its stumpy legs to the follicle wall. Since it has no reverse gear, Desch said, it may never come out again. Embedded upside down in our skin, it feeds by using those needlelike mouthparts to puncture epithelial cells and suck up the spilled fluids-with no apparent harm to us. It filters out solids even as small as the mitochondria of the cell, a feat Desch characterized as "near-perfect pre-oral digestion." The mite's digestive process yields so little waste that it doesn't even have an excretory opening. It need never get up to go to the bathroom. The follicle mite is, in truth,

"And to reproduce?" I asked Desch, with some trepidation, thinking that a mite must get lonely tucked away somewhere out on the vast, windswept expanse of the forehead. The nearest neighboring mite population centers, around the wings of the nose and in the eyelashes, are as distant as oceanic islands.

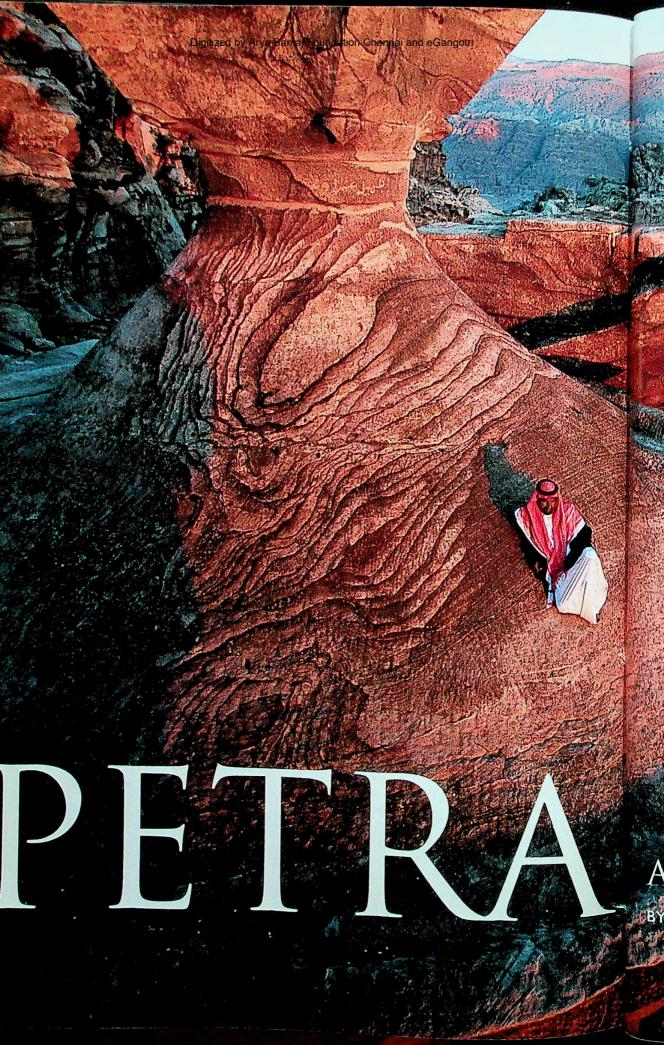
a couch potato's couch potato.

The female, Desch said, may produce a first generation asexually, by parthenogenesisthat is, virgin birth. Then she mates with her sons to produce the next generation, up to a maximum population of about ten mites per follicle. ("Oedipus should have plucked out his eyelashes and left his eyes alone," I muttered.) All this passes utterly unnoticed, "the extreme," one biologist remarks, "of an exquisite adaptation in which each of us is infested right now, but asymptomatically." Some researchers theorize that follicle mites may even benefit us in ways we do not yet understand. In any case, there is nothing, from soaps to systemic medicines, that we can do about it.

I left Desch's lab thinking that follicle mites are precisely the ectoparasite we deserve-and that we are lucky to have them, riding on our foreheads, a living reminder that our flesh is merely a part of the natural world.

Back home I offered to write my wife an ode to her follicle mites. She handed me a washrag for my forehead and suggested curtly that I keep my infestations to myself. But I knew that in the nature of life on the human habitat, it was already way too late for that.

Join the online forum on body beasts at www.national geographic.com/media/ngm/9812.



Reclining on a rooftop carved two millennia ago, a Bedouin surveys the realm of the Nabataeans, whose ancient capital beckons from the sands of southern Jordan. Forgotten for centuries, Petra still echoes with mysteries of the past; this immense building, Al Deir (the Monastery), was probably a Nabataean shrine.

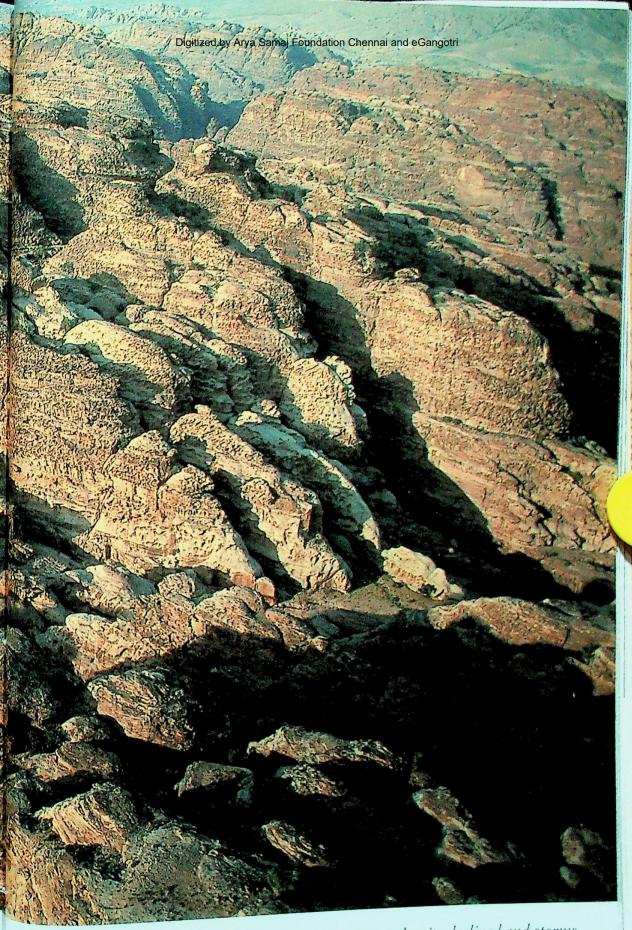
ANCIENT CITY OF STONE

BY DON BELT ASSISTANT EDITOR

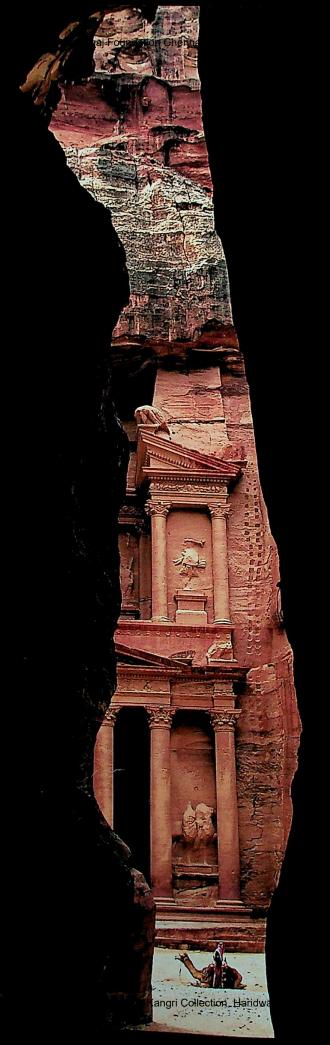
PHOTOGRAPHS BY ANNIE GRIFFITHS BELT



Etched in a monumental landscape, the Monastery, like Petra itself, is anchored in the cliffs from which it was carved. Though rattled by earthquakes through the CC-0. In Public Domain. Gurukul Kangri Collection, Hardwar



centuries, many of Petra's buildings stood fast, even as the city declined and storms of windblown sand corocal public Domain. Gurukul Kangri Collection, Haridwar



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T TOOK 12 WEEKS to get here from the frankincense groves of Oman, once the camels were loaded and the campfires stamped out. Then the caravan, single-minded as a line of ants, would set out through the morning mist, guarding its precious cargo from bandits, and pass uneasily, single file, through the treachery of Yemen.

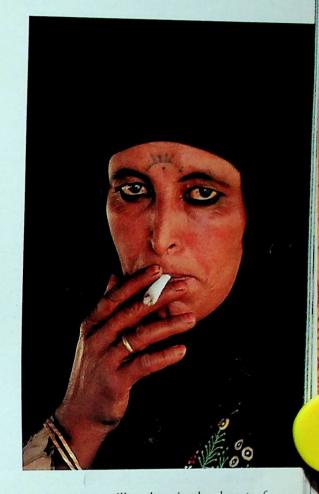
Later, if things were going well, the caravan would pause to trade at Medina, drinking from its brackish wells and gathering strength for the journey ahead. Then it would strike out north across the hellish, flint-strewn sands of western Arabia, living from one water hole to the next all the way to the capital of the Nabataeans, who ruled the lands east of the Jordan River. To the camel driver of two millennia ago, this city, Petra, beckoned like a distant star.

What a relief it must have been to see the guards on red sandstone ledges, and to be waved in after paying the toll, and to breathe the cool air inside the Siq (pronounced seek), the 250-foot-high crack in the rock that was, and still is, the main road into Petra.

For the thirsty there was water, lots of it, flowing down sinuous stone channels along the roadway; for the grateful and devout there were carved altars to Dushara, the head Nabataean god, on the chasm's sandstone walls. Boys on donkeys would dash by, shouting news of the arrival; the smell of cardamom, campfires, and searing meat promised hospitality just ahead. Finally, the caravan would swing wide around a bend to face Al Khazneh (the Treasury), that towering edifice carved from rose-colored rock, and plunge into the crowded marketplace beyond.

Two thousand years have passed, but shades

Front door of the city, the Treasury (left) dazzled the first modern European to see Petra—Johann Burckhardt, a Swiss scholar who traveled here in 1812 disguised as a Muslim pilgrim. Meeting forebears of the Bedouin who live here today (above), Burckhardt recognized the ruined city as the Petra of ancient lore, which vanished from most maps in the seventh century.



of ancient Petra still endure in the desert of southern Jordan. The facades of its buildings peer out from banks of drifted sand, and you can wander freely among them, fingertips on chiseled rock. Delicate bits of Nabataean pottery lie scattered across the land like eggshells, so numerous at times that it's hard to avoid stepping on them. And if you're out early—before the first tourist bus pulls up just past daybreak—you might even hear echoes of the ancient city, as I have, in the local Bedouin drifting by on camels in the mist or in the murmur of voices over pots of steeping tea.

After dozens of visits I've come to recognize this immediacy of the past as Petra's surpassing charm. Yet it's also the site's most profound dilemma: A living antiquity presents problems to those who would preserve the past, or uncover its secrets, or package it for mass consumption.

Like other nomadic peoples who wandered through the spotlight of history, the Nabataeans left little behind to explain themselves. They probably moved into Palestine from Arabia several centuries before Christ. By the first century B.C. their capital was a rich city shaped by the sophistication and wealth that Petra, a natural fortress on a pass through rugged mountains, acquired as a crossroads for trade.

Filling a power vacuum left by Greece's decline, the Nabataeans dominated this part of the Middle East for more than four centuries before being subjugated by the Romans, then eclipsed by the Byzantines, and finally dispersed onto the back lot of history. From sherds of their pottery we know they were artists; ancient manuscripts describe them as shrewd traders and merchants. Both qualities are reflected in Petra's public architecture, a dizzying array of temples, tombs, theaters, and other buildings chiseled out of russet sandstone. Scattered over 400 square miles and connected by trails and caravan roads, these buildings are monumental and dramatic even when judged against the Greek masterpieces of the day.

But their breakthrough achievement—the one that made all the others possible—came when the Nabataeans mastered their water supply, which enabled them to build a metropolis of 30,000 in a remote desert canyon that gets only six inches of rain each year.

Harvesting water like precious grain, the Nabataeans collected it, piped it, stored it, conserved it, prayed over it, managed it—by devising elaborate systems of hydraulics that make up, even now, the unseen musculature of Petra. Hundreds of cisterns kept Petra from dying of thirst in times of drought, while masonry dams in the surrounding hills protected the city from flash floods after bursts of rain.

That kind of planning is called for again today—as Jordan, for whom Petra is supreme in a collection of archaeological treasures, weighs decisions about how best to excavate and preserve the site while reaping economic benefit from the world's growing interest in it.

With no oil fields and few natural resources, Jordan greets the thousands of tourists who come pouring down the Siq into Petra as joyously as rainfall in the desert. The challenge will be to keep this flood of visitors from

Annie Griffiths Belt's assignments have taken her from the American Midwest to the Middle East, where she spent many a painful day photographing this story from the back of a camel.



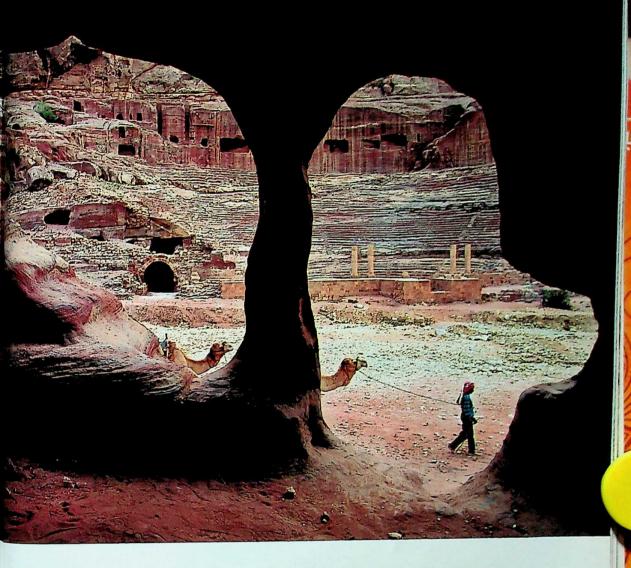
Crowned by geography, the Nabataean capital was strategically situated on a pass through the Shara mountains that divided ancient Arabia and Syria from Palestine and Egypt. A crossroads for the caravan trade, Petra prospered and built a modest empire. By A.D. 106, when Rome annexed it and expanded a Nabataean theater carved from its cliffs (right), 30,000 lived in the city.

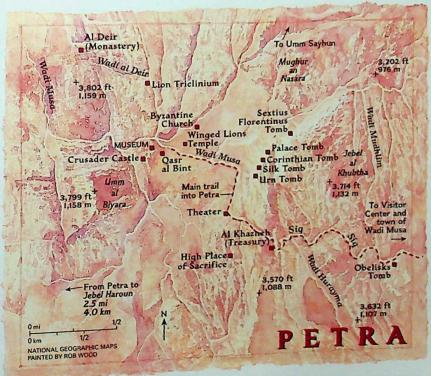


sweeping away the very features that make the place unique.

Nabataean tomb, and even there he made quite an impression. It was shortly after dawn in a stone chamber twelve feet square and six feet under, illuminated only by the murky plume of daylight that filled the rock chimney we'd used to get in.

We were excavating beneath the ruins of a fifth-century A.D. Byzantine church in Petra, and the dust was already thick enough to muffle the growl of Hamoudi's shovel as he carved chunks of hard-packed sand from a nearby grave, then deposited them gently onto the screen of my wooden sifter. I would shake the sand through, as if panning for gold, and Hamoudi would pause to check the debris left behind, plucking out sherds of pottery with fingers as fluent and precise as the bill of a bird.





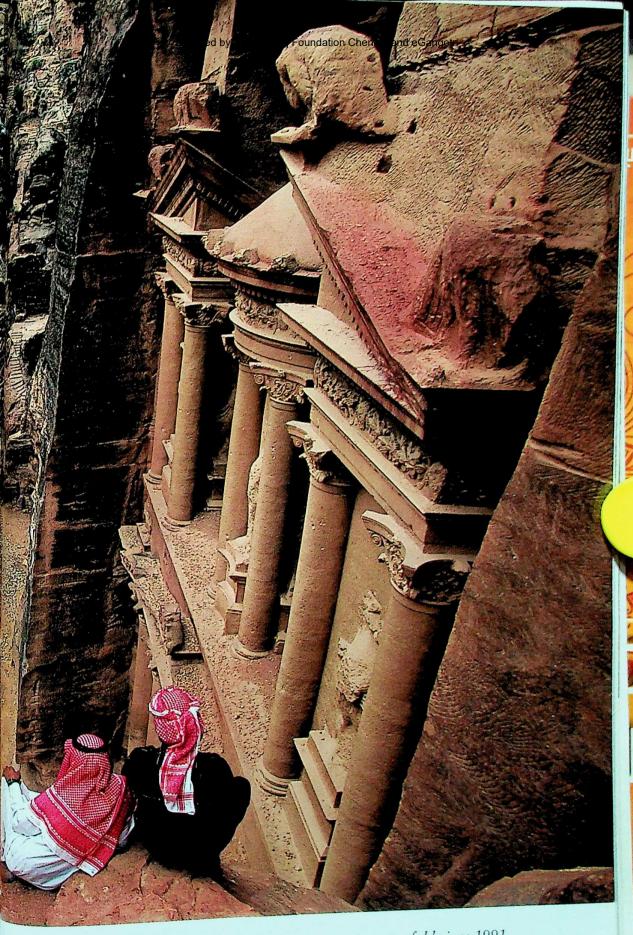
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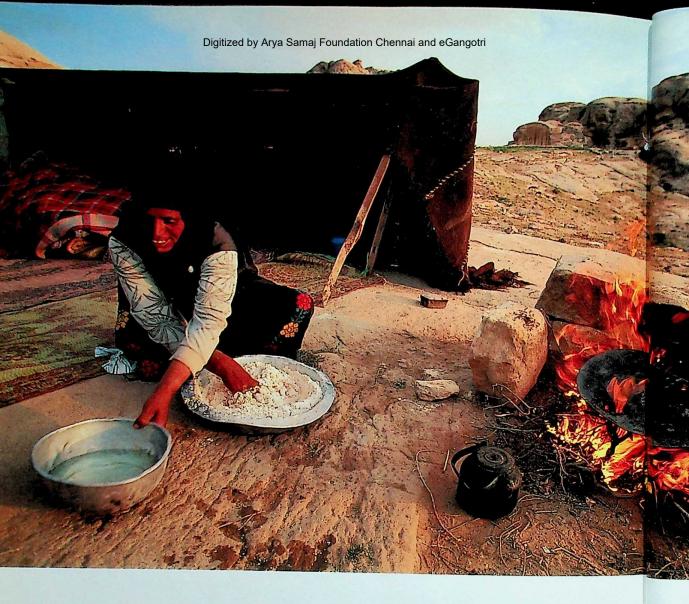
Lookouts on a ledge, Bedouins watch as a group of tourists admire Al Khazneh (the Treasury), whose function in Nabataean times is still the Khazneh CC-0. In Public Domain. Gurukul Kangri Collection, Handwarnown. Spurred by

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Jordan's peace treaty with Israel, tourism to Petra is up tenfold since 1991, boosting the economy & Markut preservation.



"Hallas," he'd finally say—"finished"—with a dismissive flick of his fingertips, and I would empty the sifter into the hollow grave I was standing in.

As the sun rose, the tomb brightened, and then I could see just enough of Hamoudi under his *kaffiyeh* to be wary of him. He was all Bedouin—short, slim, dark—and had a face as fierce as a shrike, with a pointed beak and a sharp little beard thrust forward like a dagger.

Later, after I'd gotten to know Hamoudi, I could look past this face to the merriment in his soul, and his keen unlettered intelligence, and his exuberant love of people that took us, sooner or later, to drink tea in practically every Bedouin tent in the region.

Within his tribe Hamoudi is something of a legend for his gentle way with camels and his unabashed eye for pretty girls, whom he calls, without a trace of lechery, "Bellaboooozzz!!!"

thout a trace of fechery, behavooozzziii

In the archaeology community Hamoudi is

celebrated for his professionalism and his eagle eye, both of which figured into one of the most significant finds of this century at Petra.

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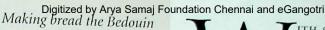
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A few years ago Hamoudi was digging in the ruins of another Byzantine church for the American Center of Oriental Research. In one corner he discovered church scrolls that had been charred when the building burned around A.D. 600 but were still legible. Experts believe these records of daily life in Petra may hold clues to the demise of the city after the Romans took control in A.D. 106 and rerouted the caravan trade away from Petra.

By the time Rome fell and the Byzantines built the church that lay in ruins above Hamoudi and me, most Nabataean tombs had been looted, and only a few thousand of the living remained for the Byzantine clergy to convert to their new religion. Earthquakes in A.D. 363 and again in 551 rocked what was left of the city, although the charred scrolls record

126





way-on hot metal over a campfire—Imhiylah al-Bedoul prepares a meal in the Petra backcountry, where her family spends the summer tending goats, using water from a Nabataean cistern. A lifelong resident of Petra, she raised six of her ten children in a cave near the city center. But after the city was made a world heritage site in 1985, the government moved the thousand-member Bedoul tribe to Umm Sayhun, a village of cinder-block houses. Though it has schools and a clinic, the village empties as the weather turns warm. "No one likes those crazy houses," says her son Mahmoud, who was nine when the family left the cave. "Petra is our home."

marriages as late as 582. Later the city was forsaken, possibly because the Nabataean channels and cisterns, long neglected, had filled with sand. Petra may simply have run dry.

Thirteen centuries of sandstorms and floods packed the ruined city in drifts and debris. Experts estimate that more than 75 percent of the urban center still lies hidden from view, which may account for the sense of imminent discovery that hangs in the air over Petra.

"Meeeoooowww!" Hamoudi yelped and fell to his knees in the grave.

"Are you OK?" I said, afraid that he'd driven the shovel blade into his sandaled foot.

"OK!" he said as he stood up carefully, balancing an unbroken ceramic bowl in his palm. He turned to me, his black eyes shining like little spotlights in the gloom. "Naba-teee-an!" he grinned, holding up the 2,000-year-old bowl like a newborn baby for me to admire. "Look, full round! In museum, same same!"

ITH SO MUCH of Petra still underground, practically every stab of a shovel yields something worth talking about. There were nearly two dozen archaeological projects under way the last time I was there, ranging from a study measuring the effect of wind erosion on Petra's sandstone facades to the unearthing of a massive building along the main street.

Some of the most spectacular recent finds involve the Siq, the cliff-lined road into Petra that was buried under sand and flood debris. In the mountains overlooking it, engineers have begun to retrace and map the Nabataeans' network of channels, basins, and dams—all built to capture and control springwater and the rainfall that gushes down toward the Siq through 19 distinct tributaries.

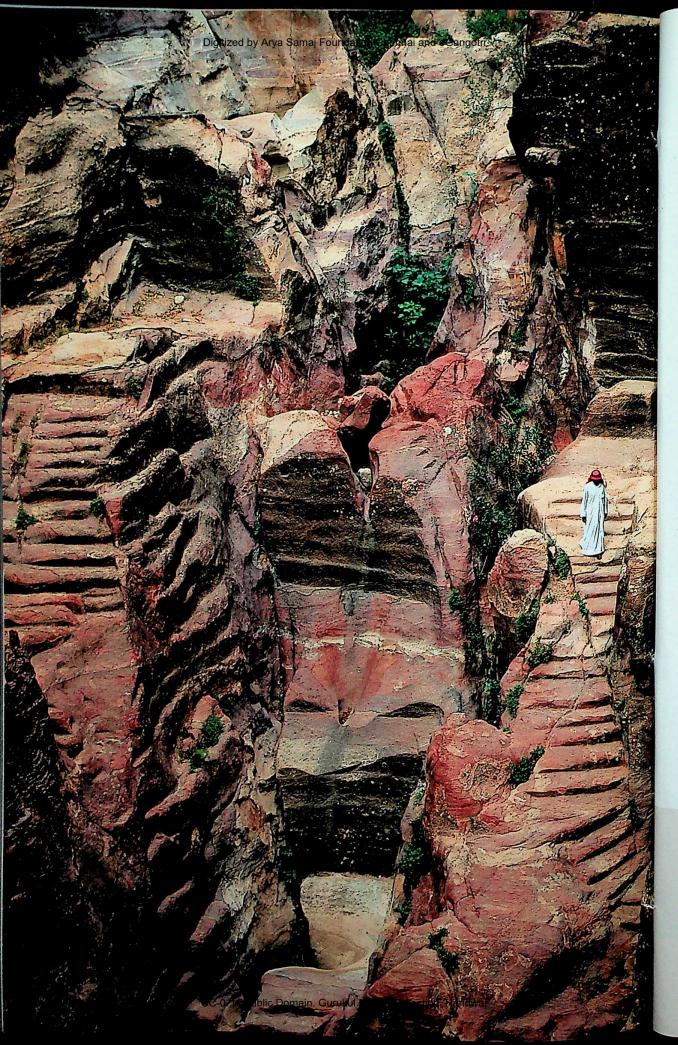
"We were astonished by how sophisticated their ideas were," said Maan al-Huneidi, who manages the project, the day I scrambled for hours over waterworks with one of his lead engineers. We found dozens of sand-filled dams tucked into the mountainside that day and almost as many cisterns carved from solid rock. Miniature canals linked one catchment area to the next, moving water downhill gracefully, sometimes whimsically, in little troughs of sandstone as finely carved as sculpture.

Last year Maan's company removed some 400,000 cubic feet of rubble from the Siq's floor, exposing the original pavement and ancient features on the chasm walls, including ceramic water pipes and a giant camel caravan carved in bas-relief from the sandstone.

I watched one morning as dozens of tourists admired this monumental carving, which is just above eye level. Some ran their hands over the stone, bringing down a faint shower of sand, while others picked idly at the wall for souvenirs. At one point a tour guide mounted a nearby Nabataean channel to deliver his spiel; he failed to mention that the plaster crumbling under his feet was two millennia old.

That man was lucky that Aysar Akrawi didn't catch his act the morning she and I toured the Siq together. As director of the nongovernmental Petra National Trust, Akrawi helped raise the half million dollars it cost to excavate the Siq—only to be reminded, daily, of how vulnerable it is once exposed.

"Petra is an exceptionally fragile site," she



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said, moments after a little boy blissfully urinated in front of us on the sandstone steps of the Treasury, Petra's most famous building. "To overdevelop it for tourism without protecting these antiquities is a huge mistake."

A look at the statistics explains why the custodians of Petra might be feeling overwhelmed. In 1991 just 41,000 people visited the site; last year nearly ten times that number did, reflecting Jordan's peace treaty with Israel and its reputation abroad as a relatively peaceful corner of the Middle East.

To handle the influx, Jordan recently borrowed some 23 million dollars from the World Bank to build new roads, tourist facilities, and other infrastructure in Wadi Musa, the boomtown that has grown up around the entrance to Petra. Only a small amount is set aside for site preservation.

"My first job is to clean up Petra," says Kamel Mahadin of the Petra Regional Planning Council, a local government bureau that will administer the World Bank funding.

Following a master plan approved by the various constituencies he serves, Mahadin began by redesigning the entrance to the site, which as recently as 1996 was a cloud of rosecolored dust and noise filled with vendors, beggars, kids on donkeys for hire, all swirling around a nucleus of stone-faced tourists in tennis shoes. Today the area is a quiet roadway.

Mahadin has also turned his attention to the Bedouin vendors inside Petra, decreeing that their medley of souvenir stands, restaurants, and animal rides be reorganized into cooperative ventures. Designed to protect the archaeology and make the site more presentable, these changes effectively limit vendors to a fraction of their former incomes. As one might expect, Mahadin's office in Wadi Musa was immediately besieged with angry Bedouin,

Laced with channels, terraces, dams, and cisterns (left, at center), the cliffs above Petra display the Nabataeans' skill at capturing and controlling rainwater-essential in a desert that gets only about six inches of rain a year. "Hydrology is the unseen beauty of Petra," says an engineer familiar with Nabataean techniques. "Those guys were absolute geniuses."

many of whom depend on tourism for a living.

It's not easy to manage a living antiquity that people will cross an ocean to see, and the government is seeking a fair solution. "Petra has many husbands," Mahadin sighs. "Everybody loves her. We know that mass tourism hurts the site, but we can't just close the gate either."

HERE IS A QUIET GRANDEUR to Petra that eludes the casual tourist, many of whom trek down the Siq to the Treasury and back out again without pausing longer than the time it takes to buy a bottle of water and a "Petra, Jordan" T-shirt. This is exactly what I did the first time I visited, giving the place a few hours one spring afternoon, seeing only a fraction of the hundred square miles that Jordan set aside as a national park in 1993.

From its center Petra extends for miles in all directions along a network of wadis, or dry riverbeds, and old caravan roads that once moved frankincense from Oman to Gaza and bracelets of gold from workshops in Aleppo to the suqs of Yemen. In recent years I've retraced those routes and felt the presence of the ancient world in everything from the plaintive traveling songs of the Bedouin to the sandpaper swish of a camel's hoof on sandstone, each as big as a salad plate, soft as a paw.

Time pokes along haphazardly here, moving to the ever changing rhythms of sun and grass and goats. One afternoon Hamoudi and I dropped by the men's tent at a wedding feast near Beida, a tree-lined wadi that serves as Petra's back door. Hamoudi, who is at home anywhere, folded his lank frame gracefully onto shaded mattresses after greeting the groom's father with fervent kisses on both cheeks. Hamoudi didn't know this family-they were of a different tribe-but for all anyone knew, he might have been a long-lost brother.

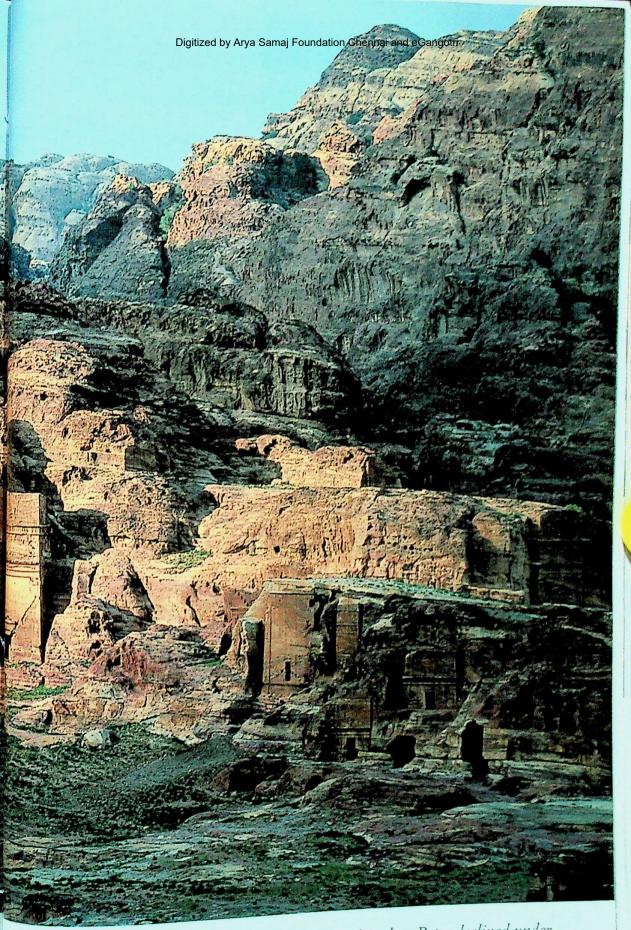
Inevitably the line of dark desert faces turned to me—the white guy in a kaffiyeh trying not to wince from the glass of scalding tea he'd been handed. Without taking their eyes off me, they asked Hamoudi where I was from. His response stirred the conversation and moved it in my direction.

"America?" said one of the younger men. "Do you know Muhammad Ali?

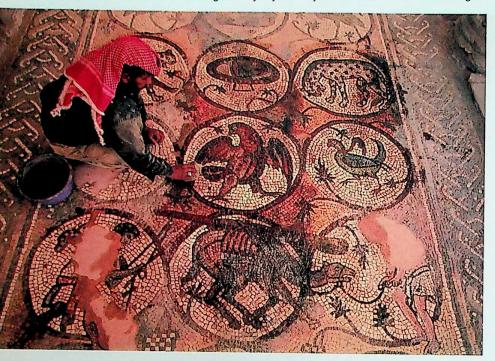
In the Petra backcountry you still find some of Hamoudi's tribe, called the Bedoul, dwelling

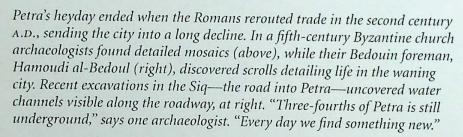


A subtle palette radiates from Nabataean tombs east of the city center. Scattered over 400 square miles, Petra includes dozens of such enclaves. Its citizens once depended CC-0. In Public Domain. Gurukul Kangri Collection, Haritagens once depended



on water piped in from surrounding mountains, though as Petra declined under Roman and Byzantin Crado, Public Comain. Gurukul Kangri Collection, Haridwar







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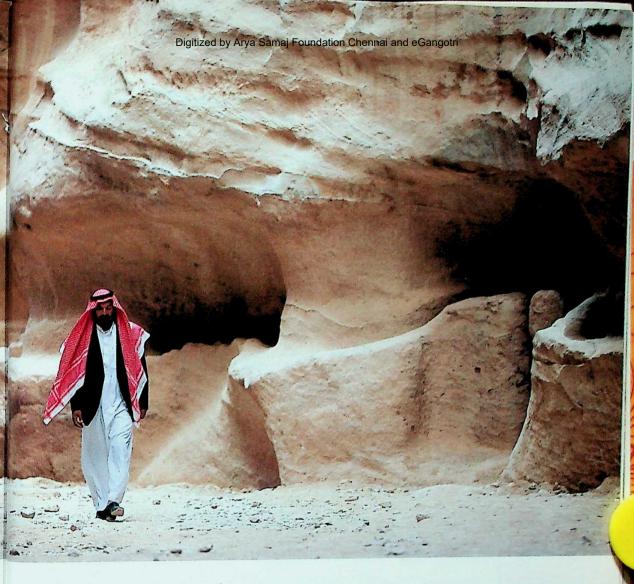
in caves, as they have for centuries. For me, this human dimension is what breathes life into Petra and elevates the place from scenic to sublime—although I understand why most of the Bedoul, including Hamoudi and his family, live today in government houses in Umm Sayhun, a dreary little village of about 1,500 overlooking the land they once called their own.

After Petra was made a UNESCO world heritage site in 1985, the tribe moved out of the caves at the government's request and with an understanding that they'd continue working inside Petra as archaeologists, laborers, and vendors while grazing their goats in the countryside. In Umm Sayhun the Bedoul have access to schools, electricity, and health care—services that have enhanced their lives.

Yet if it weren't for his four children, Hamoudi, Bedouin to the core, would prefer to sleep in the open every night. In fact, many of the villagers vanish into the countryside at the first sign of warm weather, and those who stay behind usually camp out too—on the roofs of their government houses. And though squeezed into a village, the Bedoul still know this vast region better than anyone else. When a tourist wanders off in the desert and winds up dehydrated, it's not the army, which guards Petra, that finds him, revives him, and brings him in on the back of a camel or in the bed of a pickup truck. It's one of the Bedoul.

HE CARAVAN ROAD that brought fine Chinese silks to Petra and on to Amman and Damascus passes near a massive outcrop of pale yellow sandstone about ten miles from the city center. The Bedoul call this Shamassa, the "sunny place," and if you're thirsty and out of water, it's a good place to know.

I learned this the day I stopped there to rest, leaning against a warm rock as I caught my



breath. There was a sunlit cliff across the way, with a grooved channel running horizontally along its base. After a time I walked over to investigate and saw that the channel turned the corner. From there it skirted a rock, made a clever little detour around a tree, and traversed a boulder the size of a school bus. Weaving with the contours of the sandstone, the channel suddenly made a sweeping left turn, ran through a basin, rounded another corner, then dived into a large, teardrop-shaped hole in the rock. I crept down to the rim; peering in, I saw nothing but black. A stone was fetched, tossed into the hole. I heard a distant splash.

A few weeks later I brought an archaeologist to see this example of Nabataean skill. A relative of Hamoudi's, Mahmoud al-Bedoul is 23 and the only Jordanian on record to grow up in a cave—in Petra—and go on to earn a university degree in Near Eastern archaeology. I figured he'd be interested in my find. Yet

when I showed him the secret little canal and cistern, he was strangely matter-of-fact.

"You don't seem interested, Mahmoud," I said. "Have you been here before?"

"Only thousands of times," he laughed. "I grew up here. Every summer of my life we brought our goats and camped right here by this rock. This is the cistern of my father."

He attached a cord to my canteen, lowered it into the hole, and brought it up filled to the brim. Then he took out his shirttail, placed the fabric over the hole as a filter, and took a long, savoring drink.

"Nice and cold," he said, offering the water to me—and I saw again how discoveries large and small are imminent at Petra, and how the lifeblood of an ancient city might sustain a people from that day to this.

"But is it Nabataean?" I asked.

"Of course," said Mahmoud, with a mischievous smile. "They left it to my father."

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■ FROM THE GEOGRAPHIC ARCHIVES

A Ringing in the Ears

Dressed for a celebration, a Li woman of Hainan Island in the South China Sea gives onlookers an earful. Her five-pound brass earrings, a mark of high status, were typically worn swung up onto the hair as headgear. This picture was published in our September 1938 article about her people, the largest ethnic minority on Hainan. Today's Li forgo such elaborate jewelry. Photographer T. C. Lau was a University of Pennsylvania graduate, a practicing dentist, and—by the time this photo ran—a refugee. When his home city of Canton came under Japanese attack in 1937, he and his family fled to Hong Kong. "Historians may appropriate only a line or two to record this present catastrophe, but it is tremendous to us who are in it," Lau wrote Editor Gilbert H. Grosvenor, who had been a visitor in his home just months before.



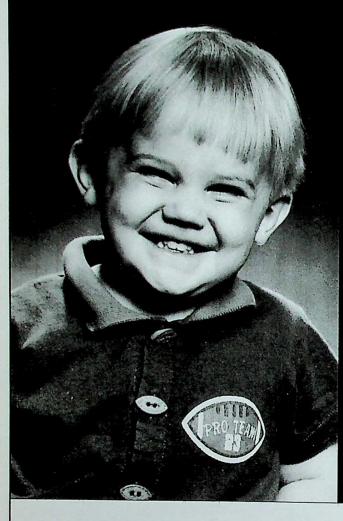
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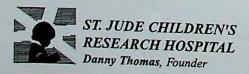
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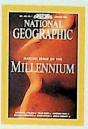
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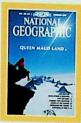
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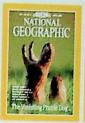
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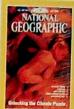




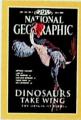










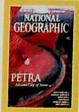












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m B}$ onuses for the senses intrigued Geographic readers in 1998. In August they soared across space to examine Mars and dived to the Atlantic Ocean floor to view Titanic, both rendered in 3-D by stereoscopic glasses bound into the magazine. In October they were treated to re-created aromas of Cleopatra's perfume and Napoleon's cologne. Logging those and other memorable journeys, a 1998 index for NATIONAL GEOGRAPHIC, TRAVELER, and World magazines will be available in February for \$6. The first 109 years of the GEOGRAPHIC, 1888-1997, are available on CD-ROM for \$149.95 and on digital video disc for \$199.95, plus postage and handling. To order, call 1-800-437-5521 or write to NGS, P.O. Box 11650, Des Moines, IA 50340-1650. An online index can be searched by going to www.nationalgeo graphic.com and clicking "NGS Publications Index."

IANUARY

Making Sense of the Millennium 2 Blackpool, England 34 Polar Bears 52 Altamaha River 72 Research Committee Report 88 Ode to Ice 96 Amelia Earhart 112

FEBRUARY

EXPLORATION 2
Revolutions in
Mapping 6
Why Explore? 40
Queen Maud Land 46
Jacques-Yves
Cousteau 70
Brides of the Sahara 80
Remember the
Maine? 92
Australia by Bike II 112
Millennium Map:
Exploration

MARCH

Blue Refuges 2 Naples Unabashed 32 Rise of Life on Earth 54 America's First Highway 82 Beetles 100 Nenets Herders 120

APRIL

Orinoco River 2 Roman Shipwrecks 32 Australia by Bike III 42 Rongelap Atoll 62 Ozarks Harmony 76 Life Grows Up 100 Prairie Dogs 116

MAY

PHYSICAL WORLD 2
Cascadia 6
Unlocking the Climate
Puzzle 38
Gray Wolves 72
Prince Edward
Island 100
Whitbread Race 118
Millennium Map:
Physical Earth

JUNE

Russia's Iron Road 2
The Elusive Quetzal 34
Orkney Islands 46
Stock Car Racing 62
Raji Honey Hunters 84
Deep Mysteries of
Kaikoura Canyon 106
Adirondack High 118

IULY

Natural Hazards 2 Lure of the Frogfish 40 Civilized Denmark 50 Dinosaurs Take Wing 74 Yukon River 100 New Inca Mummies 128 Map: Natural Hazards of North America

AUGUST

Return to Mars: 3-D 2
Orangutans 30
New York's
Chinatown 58
Bottlenose Whales 78
Redrawing Our Family
Tree 90
Indonesia Fires 100
Titanic: 3-D 120
Tear-out: 3-D Glasses

SEPTEMBER

Valley of the Kings 2 A New Day for Romania 34 Greenland Sharks 60 Vermont Seasons 72 Catherine the Great 92 Borneo's White Mountain 118

OCTOBER

POPULATION 2
Human Migration 6
Women and
Population 36
Feeding the Planet 56
Lewis and Clark 76
Perfume 94
Antarctic Desert 120
Millennium Map:
Population

NOVEMBER America's Wilderness 2

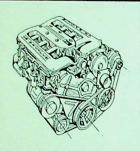
Comeback for the Cossacks 34 Maui Surf 58 Red Colobus Monkeys 72 Shackleton Expedition 82 Abusir Tomb 102

DECEMBER

Nebraska 114

South China Sea 2
Dinosaur Embryos 34
Barcelona 42
Nunataks 60
Winslow Homer 72
Body Beasts 102
Petra, Ancient City
of Stone 116
Map: Spain and Portugal

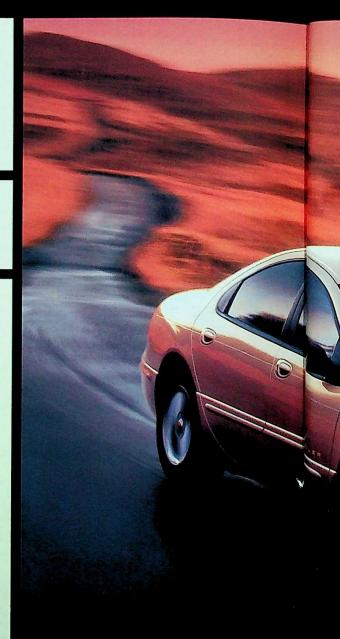
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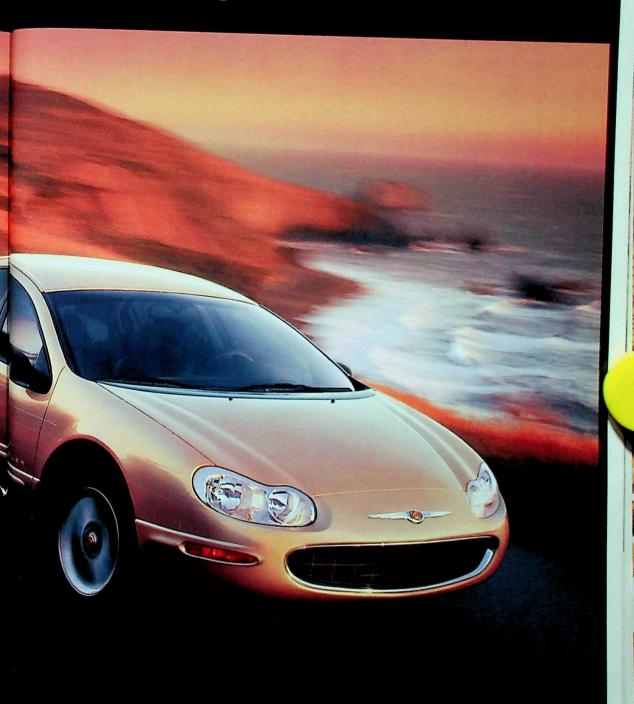
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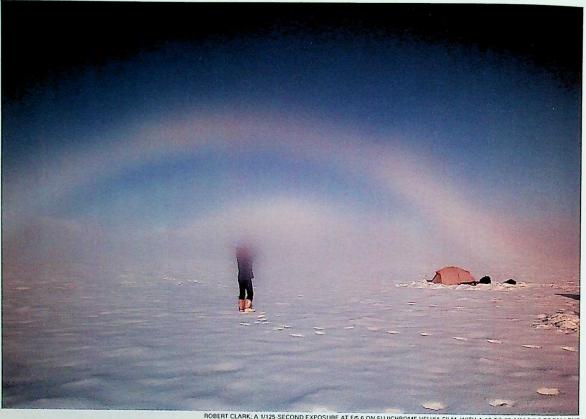
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Sometimes you forget the bread. the store altogether.





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White Rainbow

After three weeks of skiing around nunataks on the Kaskawulsh Glacier in the Yukon, our group encountered a weather pattern that brought thick ground fog up from the coast every morning, making it impossible for our plane to land and pick us up.

For five days we were trapped. To pass the time, I wrote in my journal and read short stories by Jack London. He wrote about people starving or freezing to death—I've since decided that London isn't the best thing to read when you're stuck on a glacier with a broken radio, not sure when you're getting out.

Just after 7 a.m. one morning we were making coffee, happy to see a very clear sky. As our guide, Sian Williams, and I wondered aloud if we might make it out that day, a rainbow appeared over our camp. I went for my camera and then saw a huge wall of fog coming straight down the glacier. Sian walked toward it on the way to her tent, and I kept shooting. I thought the rainbow would disappear into the mist, but it just turned white.

There's a technical explanation for this: I was actually seeing a second rainbow, white rather than multicolored because of the way fog droplets scatter light. But to me it was ground fog trapped in a rainbow, just as we were trapped in the fog.

ROBERT CLARK



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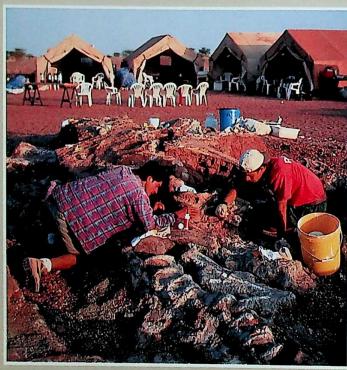
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OnScreen



HANS LARSSON

■ EXPLORER, DECEMBER 13 Dinosaur Detectives

Longer than a city bus. Weighing close to 50,000 pounds. Each footfall pounding the ground with a force greater than that of an eight-ton wrecking ball. It's an adult sauropod, one of the dinosaur giants and one of the largest land animals that ever lived.

University of Chicago paleontologist Paul Sereno searches for the bones of the beast through the desert heat of the Sahara in EXPLORER's *Dinosaur Fever*. Two colleagues who share the mission, brothers Jeff and Greg Wilson (left), unearth a skeleton of the titanic creature. The quest culminates with a rare prize: a sauropod skull, delicate and easily destroyed, that housed a brain as big as a . . . baseball.

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■ EXPLORER, DECEMBER 6 Cossacks Ride Again

Cossacks, an old saying has it, never die in their beds. For centuries those mounted warriorsfor-hire rode for Russian tsars. At times they were agents of imperial excess, and at other times they suffered from it. Perhaps descended from Mongol invaders of the 1400s, their ranks grew

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as they were joined by runaway serfs, mercenaries, and brigands. A new EXPLORER film produced by Sherry Jones examines

the past and future roles of these protectors of Russia's frontiers.

Return of the Cossacks was shot in the southern region of Kuban, which borders the Black Sea and Georgia. To the legendary "horsemen of the steppe," soldiering was, and is becoming again, a way of life and death. Cossack units are being officially accepted into the Russian Army, and Cossacks fought for Russia in Chechnya.

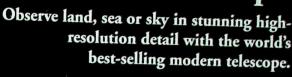
Anticipating the day when he

too can carry on the warrior tradition, a Cossack youth proudly wears a military tunic.



One meaning of "Cossack" is "free warrior." EXPLORER introduces us to today's Cossacks, who seek to reclaim their history of pride, discipline, and independence.

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by Paramahansa Yogananda

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ALL BY MARK V. ERDMANN

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NGS RESEARCH GRANT Coelacanths: A Second Site

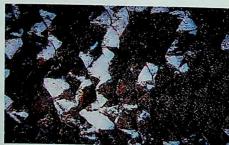
Gliding through Indonesian waters, Arnaz Mehta Erdmann swims with a strange and ancient fish, a coelacanth (above). Until now only a few hundred were thought to exist, nearly all off the Comoro Islands near Madagascar (Geographic, June 1988). But this coelacanth was found off Sulawesi, an island some 5,400 miles east of the Comoros.

Romance and science married on September 18, 1997, when Arnaz and reef ecologist Mark Erdmann were

honeymooning in the Indonesian port of Manado. In the market they saw a cart roll by with a four-foot-long fish—which Mark immediately identified as a coelacanth. "I was intrigued by its strange shape and eerie luminescent green eyes," he recalls.

Erdmann then consulted with colleague Roy L.

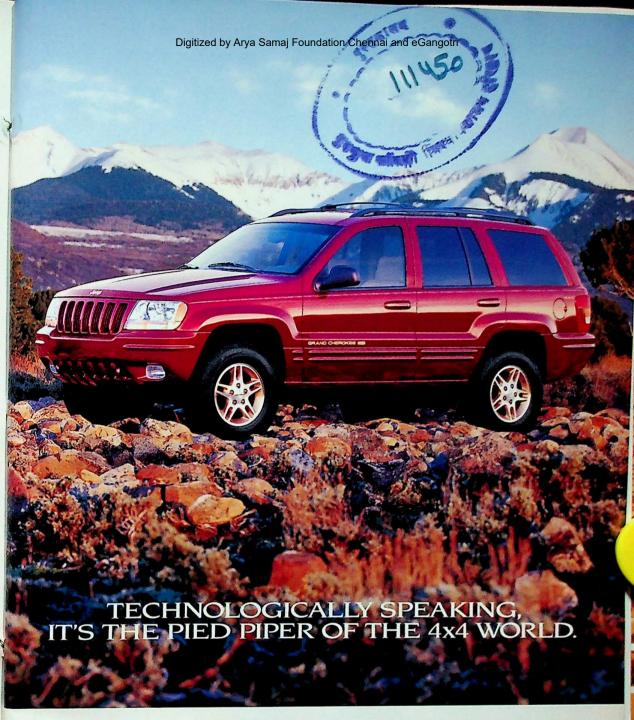




Caldwell at the University of California at Berkeley. Supported by Geographic research grants, Erdmann interviewed Indonesian fishermen: Did they ever catch such fish? Last July a shark netter delivered a barely alive coelacanth to his door. After being towed behind a boat, the fish revived. It is part of a separate Indonesian population, Erdmann feels certain. Its snout (above left) contains an electroreceptive organ, probably to detect prey. Gold-flecked scales (left) may be unique to this coelacanth population.

The oily, urea-laden fish is virtually inedible, but Erd-

mann and Caldwell worry about collectors, despite an international treaty that protects coelacanths. Indonesian authorities are working to establish safeguards. Coelacanths evolved about 400 million years ago. They were believed extinct until 1938, when one was caught in a fishing trawl.



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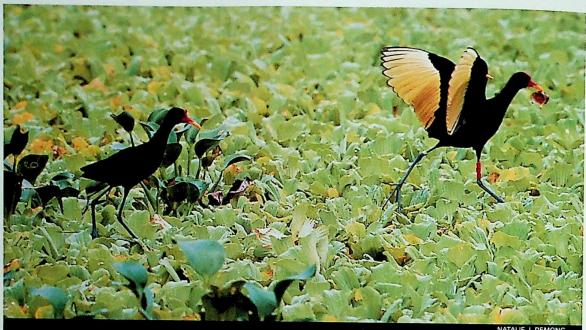
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To Get a Mate, Some Females Kill Rivals' Young

Procreation can involve infanticide among lions, primates, and birds such as these jacanas in Panama. Females keep "harems" of several males to fertilize and incubate their eggs. This female, at right, destroyed another female's eggs, which a male, at left, was sitting on. Now she skitters away with eggshell evidence in her bill. She then mates with the male. "If she didn't destroy the eggs, she would have to wait up to three months until the male finished incubating and caring for the other female's chicks," says Cornell University's Stephen T. Emlen.

New Primate Faces Appear in Brazil

Clad in golden orange fur, with an unusual lack of pigment in its skin, this species of marmoset was found in an area between the Madeira and Tapajós Rivers in Brazil's central Amazonian rain forest in 1993. Christened the Satere marmoset after a group of indigenous people in the area, the squirrel-size monkey does not seem to be threatened, according to Russell Mittermeier, president of Conservation International, which sponsors the ongoing research.

"And we're not finished yet," Mittermeier says, noting that after the Satere find three other marmoset species were discovered there. Since 1990, 11 new monkeys have been found in Brazil, bringing its primate total to 79 species, the world's highest.



CALLITHRIX SATEREI; MAURICIO DE ALMEIDA NORONHA

Fly in the Ointment for California Planners

Heir to the snail darter but even smaller? Just like the fish that stalled a dam, the Delhi Sands flower-loving fly has stirred up a hornet's nest of wrath in San Bernardino County, California, 50 miles east of Los Angeles.

Shown here slightly larger than life-size, the fly drinks nectar and hovers like a hummingbird. Development has reduced its habitat to some ten subpopulations on 450 acres of land. Perhaps a few hundred survive. In 1993 it was the first fly named to the endangered species list and caused part of a medical center—then in the planning stages—to be moved 250 feet. Some landowners are designating part of their property as fly preserves. Local officials and the U.S. Fish and Wildlife Service have been negotiating intensely.

TEXT BY JOHN L. ELIOT



HAPHIOMIDAS TERMINATUS ABDOMINALIS: GREG BALLMER



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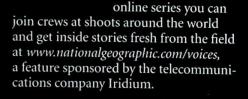
Interactive

ONLINE

Eavesdrop on Our TV Crews

Experience the wild, the wondrous, and the just plain weird by going on assignment with National Geographic Television on our website. Boyd Matson, host of EXPLORER, has ventured onto the

slopes of a simmering volcano in Mexico and dislocated his elbow in a motorcycle crash in Chile. Producer Lisa Truitt's job required her to spend three summers camping in the Arctic. Field specialist Brady Barr actually enjoyed the chore of wrestling alligators (left). In our new



MEI LEN BARR (ABOVE); DAVID EVANS, NGT (TOP); NEIL RETTIG (CENTER); SCOTT SROKA (BOTTOM)



Matson



Truitt



Barr

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THE LAB OF LUXURY

he next time you go to the post office, if you see a "Wanted" poster with a picture of a black Labrador retriever on it, he's probably mine.

His name is Walter, and he has a wit, charm and personality that could probably land him his own talk show, should he be so inclined. But he has one character flaw: He's a thief.

Befitting his breed, he's always retrieved with a tireless energy bordering on obsession. But lately his retrieving has gone beyond tennis balls and authorized socks. It's more like Grand Theft—Shoe.

I should have known something was up when two or three copies of the same morning paper would appear on the lawn. I thought the paper carrier was just taking a mulligan. I didn't realize my own dog was swiping them from my now newsdeprived neighbors.

He returned from a brief burst of freedom the other day, triumphantly toting one of those expensive European wooden sandals. I surmised he had stolen it off a neighbor's deck. He beamed like he'd found a Nobel Prize.

I loaded Labrador and his loot into my new Catera, intending to drive through the neighborhood to find a deck



with one shoe, or worse, a neighbor wearing just one. I quickly forgot my mission. The driving was just too much fun.

I had read about all the features in a newspaper ad: 200-horsepower V6 with multi-ram induction, speed-sensitive steering, traction control, on and on. But they didn't mean much until I felt them behind the wheel. My drive

around the block took me way out in the country and back.

It seems odd to pass other luxury cars on two-lane highways when you're not really in a hurry to begin with. Something about Catera makes you do it anyway. Walter smiled the whole way.

As luck would have it, on my way back up my street, I spied a neighbor searching his yard, sporting the other sandal in his hand and a puzzled look.

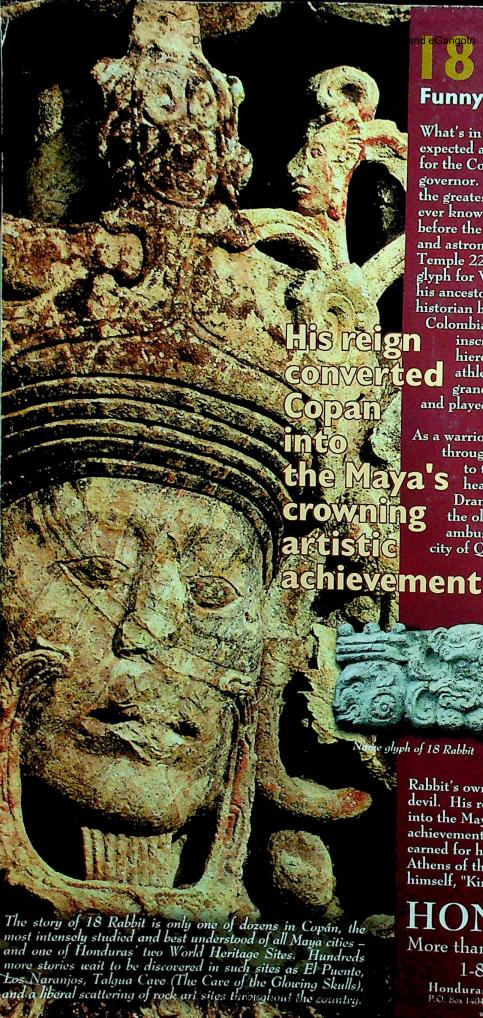
He was less interested in my explanation than in having a long discussion about my new Catera, repeatedly asking questions about feature after feature while running his hand across the leather seating areas.[†]

I asked if he'd seen the newspaper ad; he had not. He said his papers kept disappearing from his lawn. Walter and I took the Fifth.

Now, all I need is to find a support group for canine kleptomaniacs. Preferably, one that's some distance from here. I won't mind the drive.







Funny name for a King

What's in a name? You might have expected a more awe-inspiring title for the Copan Dynasty's 13th governor. Yet 18 Rabbit was one of the greatest rulers the Americas have ever known, a Renaissance man long before the Renaissance. Both priest and astronomer, he raised the stately Temple 22, and inscribed it with the glyph for Venus. In veneration of his ancestors, 18 Rabbit the historian began construction of Pre-

Colombian America's longest inscribed text, the celebrated hieroglyphic stairway. An athlete, he constructed the grandest ball court of his time,

and played ball.

As a warrior, he inspired terror throughout his empire, offering to the gods the still-beating hearts of his captives. Dramatic in death as in life, the old man was finally ambushed by guerillas from the city of Quiriguá, who ended his illustrious 43-year rule by jubilantly cutting

off his head.

His most enduring legacy is his art. The Great Plaza of Copan is scattered with remarkable stelae, monolithic sculptures intricately carved in deep, nearly full-round relief, and in 18

Rabbit's own image, the handsom devil. His reign converted Copar into the Maya's crowning artistic achievement. His great works have carned for his city the title, "The Athens of the New World", and for himself, "King of the Arts".

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